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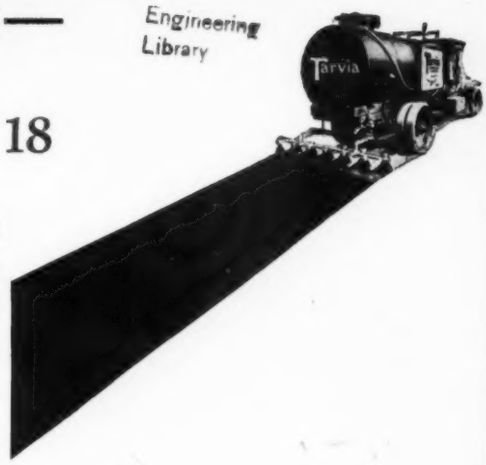

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PUBLIC WORKS
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Vol 57 April, 1926 No. 3

Sewage Works Appurtenances

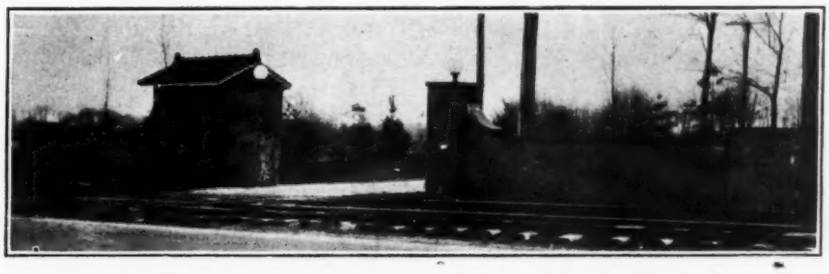
As exemplified at the Baltimore plant. Facilities for operation and attention to appearance. Electric wire conduits; transformer buildings; telephone and signaling system; lighting the grounds; tool buildings; roads.

By C. E. Keefer*

Not infrequently the designer of sewage treatment works will devote a good deal of attention and care to the planning of sewage plants, but will fail to include in his designs many features which, though not absolutely essential, add greatly to ease and convenience in the operation of sewage works. It is not enough to build grit chambers, Imhoff tanks, trickling filters, sludge drying beds, and other units which form a part of a sewage plant. In a plant of any size other improvements are essential, such as roadways, one or more buildings for the storage of tools, the planting of trees and shrubbery, and other things of minor importance.

MAIN ENTRANCE

The sewage plant, which covers about 490 acres, is on one of the main highways extending beyond the city. A road leads from this highway to the various buildings and treatment units at the plant. At the beginning of this road a small, though attractive, entrance has been built. This entrance was erected at a cost of $3,425.73. It was constructed of brick with a stucco finish and a red tile roof. It consists of a small waiting room where the public or the employees at the plant can take the trolley cars. On each side of this waiting room there are low walls. Shrubbery has been planted in the vicinity of the entrance to impart a pleasing effect.



EASTERN AVENUE ENTRANCE TO BACK RIVER SEWAGE TREATMENT WORKS

At the Baltimore sewage works an effort has been made to provide the operator with every facility to run the plant with as little difficulty as possible. Furthermore, in preparing the designs the purpose has been to create a pleasing appearance about the sewage works. Underground conduits have been substituted for unsightly pole lines; roads have been built; tool houses have been erected; and a number of trees and shrubs have been planted. What has been accomplished on a big scale at a large plant can be duplicated on a smaller scale at a small one. The following are some of the improvements which have been incorporated at the Baltimore plant. A number of these were started during the early history of the plant, and are being enlarged upon as additional treatment units are built.

UNDERGROUND CONDUITS

At present there are eight electrically operated pumping stations widely scattered about the plant. Furthermore, there are numerous other electric units, which are used for different purposes. To have run the power lines on poles from the main source of electric supply to these units would have created an unsightly condition. Furthermore, these lines would have had to be maintained, and in case of breakdowns might have greatly interferred with the operation of the sewage-works, which is dependent upon continuous electric energy. To obviate these conditions approximately 6,900 feet of fibre and multiple terra cotta ducts have been laid, and with one exception all of the cables run underground to the 17 buildings at the sewage-works. These duct

*Engineer of Sewage Disposal, Bureau of Sewers, Baltimore, Md.

lines have been designed in accordance with the best practice, with spare ducts for future cables and with large manholes spaced at frequent intervals.

TRANSFORMER BUILDINGS

Instead of erecting the transformers on poles as is frequently done, they have been placed in buildings especially designed for the purpose. Outdoor transformers are not only more costly and more unsightly than indoor ones, but they are also harder to maintain and are more likely to be hit by lightning during thunder storms. At present there are two transformer houses at the Baltimore plant. Each of these is sufficiently large to house two banks of three transformers each. These buildings have been made to harmonize with the other existing buildings, being

NEW TRANSFORMER HOUSE, BALTIMORE SEWAGE TREATMENT WORKS

built of brick with stucco finish and red tile roofs. The construction is fire-proof, and the work has been done in accordance with the specifications of the Fire Underwriters Association.

TELEPHONE AND SIGNALING SYSTEM

In a large plant covering several acres and containing many buildings, some means of communication between the buildings must be provided. There is at present a telephone system which does not meet the present requirements, and which is being replaced with modern equipment. With the present lack of facilities the operators frequently have to signal to each other by waving their hands or by some other crude method. Plans are underway to install 7,000 feet of 24 pair telephone cable between the buildings. For the present, nine of the buildings will be provided with telephones. The system will be a selective ringing, selective talking type, which means that several conversations can be carried on at the same time between stations. Moreover, a signalling system will be installed so that the foreman and the operators can be gotten in touch with within a few minutes' notice. This system will consist of several bells or sirens which will be erected at various places about the sewage works so that they can be heard at any point. Each person will be assigned a definite number of rings, and when he is wanted all the bells will ring together. He will go to the nearest telephone, and find out from the central station what he is wanted for. The installing of this system will fill a need which has been urgent for some time.

STREET LIGHTS

The lighting of a sewage works is perhaps not so essential a feature as some of the other improvements mentioned. However, when well-designed lighting units are installed, they not only make the works more attractive at night but they also facilitate the work. Along the roads, ornamental lamp posts have been installed and are equipped with 1,000 lumen lamps. Around the settling tanks and on the trickling filters, 6,000 lumen lamps are used.

TREES AND SHRUBBERY

Very frequently when a sewage works is being built, the site is regraded to such an extent that existing trees have to be removed. Such has been the case at Baltimore. To offset this, many different kinds of shrubbery and trees, mostly of the evergreen variety, have been planted, and each year additional work is done towards beautifying the grounds.

REPAIR AND TOOL BUILDING

Even a small disposal plant should be provided with a building where tools and utensils such as lawnmowers, wheel-barrows, picks, small tools, and supplies can be stored. Not infrequently an old wooden cement shed or other similar structure which has been left on the job by the contractor building the works, is mustered into service. Such a building never harmonizes with a well-designed sewage-works. Furthermore, in the majority of cases it is not adequate for the purpose for which it is used.

At the Baltimore plant there are five buildings used to store tools and equipment. One of these is a large one-story structure, containing a shop where repair work is done. It also serves as a central storage station. The other four buildings are small, and are used for the storage of small tools and miscellaneous equipment. Two of the buildings furnish toilet and locker facilities, which is an important item at a large plant where 70 or 75 men are employed.

ROADWAYS

In many respects the most important improvement at a sewage plant is good roads, which provide easy and quick access to the plant and its various parts. There are about two miles of concrete roads, 14 feet wide, at Baltimore. These roads have greatly improved the general appearance, and have also facilitated the hauling of materials used to build new improvements. These improved roads have made it more convenient for farmers to haul away sludge with ease and safety. Before the new roads were built, their trucks would get mired and many farmers would not haul the sludge because of the inconvenience to which they were put.

The work of the designer is not always finished when he has prepared plans for the treatment units only of a sewage works. Many accessory improvements have to be planned and built in order to coordinate and facilitate the operation. The extent and character of these features will naturally depend upon the size and the type of the sewage works under consideration.

The Baltimore sewage works is under the general supervision of B. L. Crozier, chief engineer of the city, and M. J. Ruark, sewerage engineer. The

writer has charge of the operation and the design of the plant, and G. K. Armeling is the superintendent.

Limestone for Sewage Trickling Filters*

Comparison with trap rock and quartz to determine relative durability. Limestone little inferior to trap.

T. C. SCHAETZLE†

Because of the presence of limestone deposits in various parts of the country, this material is usually more accessible and, therefore, cheaper to obtain for use upon sewage trickling filter beds than is the rarer meto-rhyolite or trap rock, such as is found in the neighborhood of Port Deposit, Maryland. On account of these facts, this experiment was made to determine the durability of limestone as compared to other stones which have been used in trickling filter beds under the climatic conditions existing in this latitude.

In order to subject the limestone to conditions as near those encountered in the practical operation of a trickling filter bed, it was decided to use a freezing and thawing test as the primary experiment. It was thought inadvisable to attempt an acid treatment since an acid sewage might not and, in fact, for efficiency of the beds, should not be sprayed upon them. In addition to the freezing and thawing test, it was decided to run an abrasion test to obtain some data as to the effect of freezing and thawing upon the brittleness of the various stones under investigation.

Sources and Kinds of Samples—The limestone used was a medium dark gray in color, of close texture, irregular in shape and showed no cleavage planes. For comparative studies, the trap rock used at the Baltimore city sewage treatment works since the fall of 1911, was obtained. This stone is a rather hard one, dark greenish gray in color, irregular in shape, pyritic in character and somewhat looser in texture than the limestone. A small percentage of quartz was mixed with the trap rock, some pieces of which showed cleavage planes.

Since a small percentage of quartz was found mixed with the trap rock in the filter beds at the Baltimore city sewage treatment works, it was decided to use this stone and the trap rock as blanks for comparison with the limestone so as to obtain a comparison between a fairly hard stone and one considered hard, but at the same time brittle. The quartz used was crystalline in character, yellowish white in color, stained with an iron compound and showed some cleavage planes.

Method of Making Analyses—For the purpose of gaining some information as to the hardness of the filter media under consideration, the three types of stones were subjected to an abrasion test in the standard "rattler" machine. This machine consists of two cylinders with inside dimensions of eight by eighteen inches, placed on a horizontal shaft at an angle of 30 degrees. The stones are revolved at the rate of 2,000 revolutions per minute for a period of five hours, during which time they are constantly thrown from one end to the other of the cylinder because of the angular position of the same. Before and after being placed in the "rattler," the stones were washed and thoroughly dried and then weighed. This abrasion test showed a loss in weight of 7.97 per cent for the limestone, 3.59 per cent for the quartz and 2.50 per cent for the trap rock.

The freezing test consisted of alternate freezing and thawing of the stones in the refrigerator. Each type of stone was run through graded sieves in order to learn the ranges of size. They were then placed in boxes and put in the refrigerator next to the ammonia coils. After trying this method for four days, it was found that a freezing temperature could not be obtained. A brine solution was then made and the stones placed in the boxes surrounded by ice and brine. Here again it was found impossible to obtain a sufficiently low temperature to cause freezing. It was finally found that a temperature of slightly less than 10° F. could be maintained by packing the stones between layers of ice upon which salt had been sprinkled, in much the manner as ice cream is packed. Each day the stones were removed and water, at a temperature of from 98 to 102° F. was used to thaw them. After a period of approximately an hour, they were repacked in ice, placed in the refrigerator and allowed to freeze again for an additional 24 hours. The stones were subjected to this latter treatment six times. The number of freezings and thawings was limited to six because this approximates the longest freezing period encountered in this vicinity. After the freezing and thawing experiment had been completed, the stones were thoroughly dried, graded by the sieves, run through the abrasion machine and regraded. The grading after freezing and thawing showed the effect of disintegration, whereas the abrasion test after freezing and thawing, showed the ultimate effect upon the brittleness of the stone.

Results—The analyses of the results of the test are not entirely conclusive, and, therefore, are rather difficult to interpret, but indicate that freezing and thawing had more immediate effect upon quartz than upon either of the other stones.

PER CENT LOSS OF WEIGHT OF FILTER MEDIA DUE TO FREEZING AND ABRASION.

	By Abrasion before Freezing and Thawing	By Freezing and Thawing	By Abrasion after Freezing and Thawing
Quartz	3.59	1.33	5.11
Trap Rock	2.50	0.20	2.99
Limestone	7.97	0.74	7.25

The relative effect upon the limestone, as compared with the trap rock, shows that the former lost practically four times more in weight by freezing than the trap rock which, as previously stated, has been in service at the Baltimore City Sewage Treatment Works for about twelve years without an appreciable increase in the smaller sizes of stone.

*From the Bulletin of the Maryland State Department of Health.

†Senior Assistant Sanitary Engineer, Bureau of Sanitary Engineering.

Conclusions—The general conclusion to be drawn from these tests is that, since the increase in the smaller sizes of stone is slight, there should be no appreciable amount of pooling on the trickling filter, and, therefore, no detrimental effect upon the normal oxidizing power of the filter. It would seem from these experiments that limestone may be used as well as the harder trap rock, but that more frequent replacement of stone would probably be necessary. The decision as to the kind of stone to be used, therefore, must be based upon the economics of the problem at hand rather than upon engineering judgment of the life and efficiency of the stones under consideration.

In this study no attempt has been made at evaluation of the chemical effect of limestone on the treatment process itself. This matter has been left to further plant study.

A Municipal Tourist Camp in Florida

West Palm Beach has just completed a four hundred thousand dollar camp of bungalows, tents and tent sites, with water supply, sewage, electric lights, stores and community hall, accommodating four thousand persons and giving a gross income of more than fifteen thousand a month.

By E. L. Filby*

The problem of tourist camps is an important one in Florida and the State Board of Health, through its engineering bureau, has been giving the matter close attention for the past year in all parts of the state. There were ninety-five camps during the winter of 1924-1925, and these have increased this winter to two hundred and ten, containing more than 125,000 people, with new ones coming in all the time. These are all certified camps—others are permitted to operate only in very rare instances.

To be a certified camp, the site must be well drained, on sandy soil and shaded; safe drinking water must be provided under pressure, flush-type toilets of ample number, safe sewage disposal, and shower baths, usually with hot water as well as cool. There must be garbage cans of galvanized iron with cover, trash burners and electric lights. Streets and plots must be regularly laid out. An attendant must be present at all times who is held responsible for the cleanliness of the camp and maintains a central office where he keeps a register of all parties in the camp. Inspections by state inspectors several times a month keep him on the alert, and in addition, if the camp is in a city, the city health department often makes more inspections than the state. We have had eight men at this work all the fall and added three additional men this winter. Recently we adopted the rule that no dogs will be allowed in camps unless a certificate of a veterinary can be produced showing that they have been vaccinated against rabies; which rule has not yet been enforced except at the city of West Palm Beach. We have had little typhoid in the camps. In inspecting a proposed site, special attention should be given to eliminating low, wet areas, as clay soils can not well be used for sanitary camps.

Remarkably little trouble has been given by these camps, the owners of which are proud to have their camps in our certified list, which is published monthly on a large poster and sent to every camp, auto club and chamber of commerce in the state. By cooperating with camp owners' associations and the managers, we have succeeded in putting "fly by night" camps out of existence. State control through law rather than state health department regulations should be obtained, although we have been very successful in operating under a health department regulation.

Most of these are private camps, but a few are

*Chief Engineer of Florida State Board of Health.

MAKING A STREET IN THE BUNGALOW SECTION

municipally owned and operated. That at West Palm Beach known as "Bacon Park" is a model from which others may well pattern and will be described in this article. It is an excellent example of how city departments can cooperate in this work. At West Palm Beach the Parks Department has done an excellent job in setting out royal palms, mangoes and shrubbery, and fountains; the city Sanitary Department handles the garbage; the Street Department has built oiled lime rock roads; and the city commissioners through C. A. Bingham, city manager, have left nothing undone to make this camp an attractive one. No private camps are allowed in the city. This is not a free camp but rentals are charged and the gross income of this camp will exceed $15,000 a month. The camp is expecting to care for something over 4,000 people. It has received the most favorable comment from city, state and federal officials, as well as officials from other states, and the plans have been eagerly sought by other officials confronted with similar problems.

The city of West Palm Beach in 1921 created by ordinance an automobile tourist camp in an area originally designated as a city park, which is located along the western slope of the sand ridge that lay west of the city. It was then some distance from the built-up section but is now surrounded by a high class residence section and is crowded to capacity. Rules and regulations were prescribed in the ordinance providing for proper maintenance and a charge of 25c per day. The fees have been now raised to 50c per day per car and bring in approximately $9,700 a month gross to the city.

In 1923 it became a problem how to handle the influx of working people, city employees and tourists. Homes could not be secured at any price and many could not afford the prices demanded. Building operations, municipal improvements, etc., could not go on unless the men and their families could find somewhere to live, and many were leaving daily. To cope with this serious situation, Mr. Bingham included in an issue of bonds, for some thirteen projects, the sum of $400,000 for acquisition and improvement of an auto park. The entire issue was for two million dollars and only twenty votes were cast against it.

In the southwestern section of the town was an old lake bottom that had been drained by one of the Lake Okeechobee canals. The high land about this lake had been homesteaded years ago by C. C. Bacon and the lake itself was the subject of title dispute. The city purchased from Mr. Bacon, for the camp site proper, 36 acres of land for $180,000, a very reasonable cost, and took riparian claims of about 43 acres additional as a park and city nursery. The lake bottom and some of the Bacon property is muck land and the entire area developed was covered with a sand layer at least six inches deep.

Work of construction was started during the summer of 1924 and would have been completed by December 1, 1925 but embargo on building materials so delayed the contractor that it is not yet entirely completed. All work on the camp was done at cost plus 10 percent. Plumbers wages ran as high as $18 per eight-hour day.

Designing of the camp and the engineering work was done by the engineering department under T. B. Henry, city engineer, and beautifying and upkeep by the Park and Grounds department of which Frank Mathis is superintendent. Direct management of the camp is in charge of Eugene Butler and an assistant. Three special policemen act as inspectors and watchmen, working eight-hour shifts, and there is a full-time sanitary inspector in addition. Adjoining the camp is a city nursery where ornamental stock are grown; also some fresh vegetables which are sold through the community store.

This camp, named "Bacon Park," is a city in itself with all conveniences provided. The city rents the houses, tents and tent sites, furnishing with the rental water under high pressure, lights, sewerage, laundries, community dance hall with stage and radio, paved streets, fire protection, garbage collection, etc. Bungalows are rented at $65 per month, including water, electric light and sewerage. They cost about $1,500 to complete, not including $300 for furnishing, and it is estimated that in three years they will pay for themselves. The demand far ex-

BUNGALOW SECTION. FLORAL PARK IN FOREGROUND

ceeds the supply, many city employees in high positions living there. What are known as "close to nature" houses are rented at $35 and $30 per month, and tents at $5 per week. For the true "tincanner" who brings his own tent and outfit, spaces 30 by 30 feet are laid out and rent at 50c per night. Bus service to town operates on a half-hourly schedule from six in the morning to midnight.

The camp is divided into three sections. On entering the camp first comes the administration building and store building. The latter is a community store which is rented, with exclusive right to sell groceries, meats, gas, etc., for $3,600 a year. In this building is a "Piggly Wiggly" style grocery store, meat market, dry goods counter, drug counter, four-table pool room, restaurant, post office and news stand, and a gas, oil, tire and accessory store. The prices charged here compete with the down-town retail stores.

Passing these buildings one enters the bungalow section where there are 84 three-room bungalows of frame construction elevated two feet above the ground, painted on the outside, but not ceiled or painted on the inside. Each is on a 40 by 40 foot lot facing the main thoroughfare of the camp, Bacon avenue. Space is provided for parking cars at the side of the bungalow. Each bungalow is 14 by 28 feet with a six-foot porch additional. The main living room, 10 by 14 feet with three large windows, is entered from the porch. Behind this is a bedroom with two windows and behind that is kitchen, bathroom and closet. The kitchen is about 7 by 8 feet and has two windows and a rear exit. The bathroom has a window in the rear of the house. All outside windows and doors are screened and shades are furnished and five electric drop lights. The rooms are about 8 feet high. The roof is covered with fire resisting material. In the kitchen are shelves, a sink and drain board. The toilet furnishings consist of a standard low tank type of porcelain toilet, lavatory and shower bath with concrete floor. No hot water is provided under pressure but the climate is such that cold water showers are acceptable. Hot water is furnished in the public laundries. Unlimited water and light service is provided. These bungalows are quite completely furnished, there being a wicker living room table,

ENTRANCE TO TOURIST CAMP
Administration building on right; community store on left

COMMUNITY BUILDING—DANCING, RADIO AND OTHER AMUSEMENTS AND LUNCH STAND

two cane rockers, a day couch bed, a double steel bed with spring and mattress and two pillows, a dresser and six unpainted chairs. In the kitchen is a three-burner "Perfection" oil stove with a two-burner oven, a 25-pound capacity refrigerator and a drop-leaf unpainted table. There are also furnished the necessary kitchen and table utensils such as pans, kettles, cups, saucers and plates, knives, forks and spoons, carving knife, can opener, etc.; also galvanized washtub, brass wash board, ironing board, kerosene and garbage cans. Also the necessary bed clothing including two pair double blankets, sheets, towels, pillow slips, etc.

In the next section of the camp are 68 "close to nature" houses, 20 of which are 12 by 24 feet and the others 12 by 18 feet. These are canvas houses on a wooden floor and frame, there being a 2½ foot opening all around the house which is screened; the screened opening being equipped with an outside canvas screen operated from the inside so they can be kept dry in wet weather. These tent houses have only one door. They are furnished with double bed and mattress, four chairs, one table, three-burner oil stove, refrigerator, garbage can, oil can, and Deitz lantern. In the alley at the rear are a faucet connected to a water main and a catch basin connected to the sewer, there being one for each four tents. At convenient locations are comfort stations in each of four of which women are provided with 12 toilet compartments, six showers and dressing rooms, and a six-spigot wash trough; while in each of four others there are provided for men 12 toilets, 8 showers, and a 5-spigot wash trough and a urinal trough. Concrete floors and drains and electric lights are provided and ample screened windows. A man and a woman are in attendance at these stations during the day so that they can be kept clean and in order.

Next in order come 100 tents on wooden floors. These tents are 10 by 14 feet with sides 3 feet high and 6 feet high at the center (these are now being raised by building 3 foot wooden sides). They are furnished with two iron cots and mattresses, two camp stools, a two-burner oil stove and oven, a kerosene lantern and a garbage can. Outside water spigots are provided and comfort stations similar to those described above are conveniently located. Two large open fire places with concrete benches are provided in this section.

Laundries are located at three points, each containing 15 two-section stoneware tubs with hot and cold water, which is provided free. There are yard lines for drying clothes.

A community dance hall 50 by 100 feet has just been completed containing a 25-foot stage. Here there will be a soft drink and sandwich stand. One of the residents of the camp has furnished for it

"CLOSE TO NATURE" HOUSES

a $1,500 radio receiving set and four loud speakers.

There was also completed in February a large storehouse for extra furniture, a first aid building, and a jail.

Sewage is disposed of by treatment in two septic tanks followed by dilution into the canal. As the topography was too flat to permit of gravity flow throughout, it was necessary to build two stations in which automatically operated electric centrifugal pumps lift the sewage. Water is taken from a 40-foot driven well and pumped to a 50,000-gallon steel tank elevated 85 feet. Fire protection is provided by 4-inch mains with fire hydrants, each supplied with a small house containing 250 feet of hose permanently attached. A small LaFrance hand-drawn chemical tank is provided. Six employees are drilled as a fire squad.

Hog Feeding at Flint, Mich.*

City of about 135,000 population made a profit of $40,000 last year from feeding its garbage to 1,000 to 1,700 hogs, thus reducing cost of collection.

By Nahum W. Long†

The city of Flint was fortunate in securing a run-down farm situated about twelve miles out, with running water on three sides, and a railroad running through one corner of the farm, making it possible to have their own siding with loading chutes and sorting yards, enabling them both to receive and ship in carload lots, avoiding the expense of trucking each way as most cities have to do. Enough hog barns have been erected to take care of any amount of hogs that may be run on the farm at any time, the number ranging from one thousand to seventeen hundred head, according to the flow of garbage.

The soil of this farm is sand and will absorb sufficient moisture to permit feeding in the field at all times. The garbage is delivered in twin tank trailers of ten tons capacity. At this time of year, our daily average is about seventy tons.

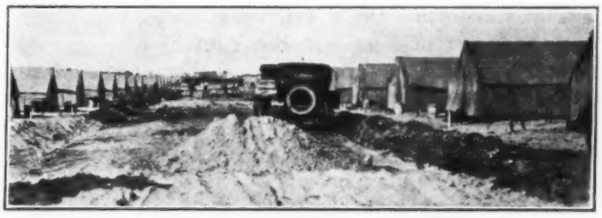
We feed across the field on a strip about two rods wide, our trailer being equipped so that the garbage is gradually strewn in long windrows, allowing all the hogs to feed at the same time without piling up as they would if it were unloaded in heaps. We continue on this strip until it has been completely covered; then another strip is taken and fed over the same way.

While the rule calls for the separation of tin cans from the garbage, there are always some that find their way in and, before the land can be plowed, it is necessary to pick them up and remove them to a dump. The bones are picked up and drawn from the farm at no expense to us.

After the ground has been cleaned of bones and tin cans it is plowed very deep. This method is followed until the whole field has been plowed. We then start at the place of beginning and follow the same method, only plowing less deeply, making it possible to place one layer of refuse above the other. By the time winter comes, we have fed and plowed the field twice. We continue to feed this field during the winter, plowing the same in the spring and planting to corn, which is our only crop. In using this method we have succeeded in reducing the odors to a minimum and restored fertility to the soil, thus giving bumper crops of corn which, after being husked by machines, gives us both emergency feed and bedding.

Great care should be taken in the selection of feeders. We have found that the best success can be had by securing hogs raised in a climate similar to our own; also, that the rangy type of hog weighing from one hundred twenty-five to one hundred thirty pounds is best suited to our purpose. In order to get this type of hog, it is necessary to buy the Minnesota and Dakota pigs. These are bought at St. Paul, Minn. Before they can be shipped they have to be vaccinated for cholera; we also have an extra shot given for pneumonia and influenza. These treatments and the freight add about one and one-half cents per pound to the original cost of the hogs. We have found that this way of buying is more satisfactory than buying locally, as we are able to get the size, weight and quantity wanted practically at once.

Upon their arrival here they are placed upon



STREET UNDER CONSTRUCTION IN TENT SECTION.
Note garbage can in front of each tent

TOILET FACILITIES FOR TENT SECTION

*Paper before League of Kansas Municipalities.
†Garbage Commissioner of Flint, Mich.

a special diet for about five days, then gradually fed garbage until they get all they can eat. In about ninety days they will have doubled their weight and are ready for the market. The annual turnover is around 4,800 head.

The writer's experience on the western stock ranges convinced him that hogs would do better if run in herds of about the same size and weight. After each shipment, a general grading is made so that all our herds are uniform in weight.

There is bound to be some loss at a garbage feeding plant as it is humanly impossible to educate people to realize that razor blades, phonograph needles and the like make a very poor hog feed. Our loss from all causes was around three hundred, which is not alarming when considering the nature of the feed and the number of hogs handled. Last year's profit from feeding was over $40,000 and no reason can be given that would indicate a smaller profit for the current year.

I have purposely refrained from using any delivery costs, as our delivery and collection costs are figured in the same fund, our method of garbage collection being a separate story. Only the actual profit of feeding is given. Any profits that arise from garbage feeding are used to lighten the cost of collection; said cost being raised by direct tax levy of 25 cents on every $1,000 of valuation, making the yearly cost to the ordinary householder from one to three dollars.

Building California Concrete Roads

Instructions prepared by State Highway Department have resulted in increasing strength of pavements sixty per cent by improving quality of concrete.

The California State Highway Department has prepared instructions for the control of concrete mixtures, which are given below. Since their adoption as a standard, the average strength of the state's concrete pavements has been increased from approximately 2500 pounds per square inch, at 28 days, to about 4000 pounds per square inch. In practical effect, if computed according to Older's corner break formula, this is equivalent to thickening the edge of the pavement about 26 per cent without adding any material or incurring additional expense.

In a recent discussion of the matter, R. M. Morton, state highway engineer, said:

"In the design of concrete pavements, there are two ways in which additional strength to withstand traffic impact may be secured. One method is to increase the thickness and to improve the design of the cross section so that the greatest strength will be at the point where loading is the heaviest. Increased thickness means increased cost and economic considerations prevent unlimited improvement in this direction.

"The other method of increasing the strength and wearing power of pavements is by improving the quality of the concrete used in them, and, as this method gives added strength at a very slight increase in cost, it should be utilized as far as possible.

"During the last two years much progress has been made in increasing the strength of the pavement by improving the quality of the concrete. This has been accomplished by more careful and rigid field and laboratory control of the materials and methods used, and by modernizing the design of the mixture. The amount of cement used, six sacks per cubic yard of concrete, has not been increased.

"In earlier construction, the compressive strength of concrete at twenty-eight days ranged from 1800 to 2200 pounds. During the present year, the strength has averaged from 3500 to 5000 pounds per square inch on various projects. Cores drilled from pavements in the 1920 study, at ages of one to five years, gave strengths of about 3800 pounds per square inch. Year-old cores from pavement laid last year show strengths above 5000 pounds per square inch and average strengths for ninety-day cores, drilled from pavements laid this year, range from 4500 to more than 6000 pounds. This increased strength of concrete is had at little, if any, added cost and gives a substantial additional factor of safety in the pavement.

"The longitudinal center joint has been adopted in California as a means for preventing longitudinal cracking. No attempt has been made to hinge the panels together by dowelling across this center joint. Thickness has been increased to nine inches at edges and along the center joint, reducing to a six-inch thickness two and one-half feet in from the edge and center. In reconstruction, the same section is used with a five-inch minimum thickness over the center of the old pavement.

The instructions which follow are included within each pad of the construction department's form for daily reports on concrete construction.

1. Read carefully Section III of the Manual of Instructions of the Construction Department.

2. The following field testing equipment will be necessary and will be furnished by the Laboratory on requisition:

1 set of 8" Tyler standard sieves of the following mesh sizes: No. 1, No. 10, No. 20, No. 30, No. 40, No. 80, No. 200 and pan.

Plate screens, 16" square, punched with round openings of the following sizes: 2½", 2", 1½", ¾" and ½".

1 quartering canvas, 18" x 24," for sampling rock and sand for sieving.

1 percentage scale weighing to five pounds, Fairbanks-Morse No. 485 recommended.

A 50-foot metallic tape.

A 2-foot rule.

A supply of report forms, R-16, Revised.

Note.—In addition to the equipment listed above, each resident engineer should have one platform scale weighing to 150 pounds or an accurate spring balance having a capacity of at least 50 pounds.

3. The resident engineer should secure or construct quarters adjacent to bins or material storage in which field testing can be carried on and in which equipment will be properly cared for. It should include a work table and shelves or racks upon which equipment can be stored. Some additional equipment which may be obtained locally will be found desirable. This will include a dozen tin bake pans about

10 x 12 inches, a sheet of galvanized iron about 3' x 10', on which aggregates may be dried, a galvanized bucket, and a one cubic-foot measuring box.

Sieve test for sand—Ascertain source of sand and check up laboratory reports to determine whether sand has been *approved for use*. Secure 25-pound average sample of sand by digging into stock piles at various places. If a sampling tube is used, a smaller sample will be satisfactory. Quarter sample down to about one-fourth and weigh out exactly five pounds. Dry separately in pans or on galvanized iron sheet. Weigh after drying and determine percentage of water in sand.

$$\text{Water content } (\%) = \frac{\text{Wet weight—Dry weight}}{\text{Dry Weight}} \times 100 \quad (1)$$

Add enough dry sand to bring sample up to five pounds and sieve first through a No. 3 sieve, then in succession through finer sieves and record as follows:

Sieve Analysis	Total per cent retained (Cumulative)	Per cent passing (= 100% — Per cent retained)
No. 3 Sieve	.....	.....
No. 10 Sieve	.....	.....
No. 20 Sieve	.....	.....
No. 30 Sieve	.....	.....(2)
No. 40 Sieve	.....	.....
No. 80 Sieve	.....	.....
No. 200 Sieve	.....	.....

(Five-pound Fairbanks scales No. 485 give percentages passing by direct reading).

Compare the sieve test results with the grading specifications for fine aggregate, and, if corrections are necessary, promptly notify the contractor in order that same may be made.

Swell of sand due to moisture content.—Measure exactly one cubic foot of sand from stock piles without drying, dumping sand loosely in measuring box from a shovel held just above the edge of the box. Before moving the box, strike off with a straightedge. Weigh wet sand. Dry this sand on galanvanized iron sheet and weigh carefully. Replace sand in measuring box loosely as above described. Add enough sand which has been dried separately to fill measuring box and strike. Weigh sand in box. Per cent swell of sand due to moisture will be calculated as follows:

(a) Weight of cubic foot moist sand (as received).....
(b) Weight of same sand after drying .....
(c) Weight of one cubic foot dry sand .....

Referring to weights by reference characters: % Swell

$$\text{of sand due to moisture} = \frac{c-b}{c} \times 100. \quad (3)$$

Caution—After filling measuring box with loose sand, any movement of the box or jarring will lower surface of sand. *Do not refill* before weighing.

Sieve analysis of coarse aggregate.—In order to insure uniformity in concrete, it is usually specified that coarse aggregate shall be furnished in two sizes to be kept in separate stock piles. In such cases, both sizes of aggregate shall be sampled and sieve analyses made as described for sand except that much larger samples shall be tested. One hundred pound samples should be tested when possible, and twenty-five pounds shall be the minimum size of coarse aggregate samples.

After making sieve analysis of both sizes of coarse aggregate, determine the proportionate quantities which will most nearly give the combined grading specified for coarse aggregate. Make a combined sample, 300 to 500 pounds, in the proportions believed to be correct. Mix thoroughly and quarter down to one cubic foot. Then make moisture and void determinations of the combined sample as hereinafter described and after this, a screen analysis of the same combined coarse aggregate sample.

Coarse aggregate segregates readily in handling, and when it is supplied in one size, great care should be taken to see that every sample screened is typical of the material to be used.

Combined Mixture—The combined mixture should be computed from the fine and coarse aggregate sievings. The data noted in the combined mix column shall be the typical mix run during the day. Sieve results need not be tabulated closer than one-half per cent.

Moisture content of coarse aggregate—Determine as for sand except that this determination is best made on a large sample, 25 to 100 pounds.

Information regarding moisture content in the sand and coarse aggregate should be sent immediately to the assistant at mixer in order that the water per batch may be adjusted accordingly.

Void determinations—The purpose of the screen analysis is primarily to determine whether material conforms to a predetermined grading which is known to be associated with a low percentage of voids. The yield of concrete is largely dependent upon percentage of voids in aggregate, therefore voids shauld be determined in the field.

To make this test, it is necessary that you know the specific gravity of the material. This will be shown on the material test report, but in case your record does not show it, wire or write the laboratory for the information. With specific gravity of aggregate known, proceed as follows:

(e) = Weight of one cubic foot loose measure of dry sand or coarse aggregate.

(f) = 62.4 X specific gravity of material.

Apparent volume is volume measured dry and loose.

$$\text{Absolute volume} = \frac{e}{f} \times \text{apparent volume.} \quad (4)$$

$$\text{Voids} = \text{apparent volume—absolute volume.} \quad (5)$$

$$\%\ \text{Voids} = \frac{\text{Voids in cubic feet}}{\text{Apparent volume in cubic feet}} \times 100 \quad (6)$$

Design of concrete mixtures—The more important considerations entering into the design of concrete mixtures are:

Workability, Strength, Density, Uniformity and Economical Use of Cement.

In our specifications the amount of cement for Class "A" concrete is fixed at six sacks per cubic yard. In order to secure maximum strength, density and reasonable workability, the grading of coarse and fine aggregate should be that which, within specification limits, will give the lowest percentages of voids.

The amount of fine aggregate should be kept at the minimum which will provide sufficient mortar to fill all voids in coarse aggregate and which will provide the small surplus necessary for finishing. With ordinary coarse aggregate, the amount of sand required will be about 20 per cent more than enough to fill the voids in the coarse aggregate

Concrete consists of cement, sand and rock particles with voids or interstices between the particles filled with water or air.

This may be expressed in the following formula:

$$\text{Volume of concrete} = C+S+R+V \text{ and} \quad (7)$$

$$\text{Volume of concrete} - V = C+S+R \quad (8)$$

In this formula V is the space occupied by water and air, usually referred to as "voids." C is the *"absolute volume"* of cement the voids all being included in V. S and R refer, respectively, to *absolutely volumes* of sand and rock. This formula for *absolute volumes* has been mathematically derived from a consideration of *apparent volumes* or volumes as they appear when measured, and may be accepted as correct.

Yield of concrete—The combined volume C+S+R in Formula (8) has been found by experience to be about .82 of the volume of the concrete. This factor may vary slightly with the *complaisance* of materials which is their faculty of fitting together in a dense mass. In general, it may be accepted as covering average laboratory conditons. For convenience, this ratio of the combined value of C+S+R to the volume of concrete has been termed the "coefficient" of yield and may be expressed as follows:

$$\text{"Coeff."} = \frac{C+S+R}{\text{Vol. of Conc.}} \quad (9)$$

and by transposing, we have the "yield," or volume, of concrete as follows:

$$\text{Volume of concrete} = \frac{C+S+R}{\text{Coeff.}} \quad (10)$$

In field work there are losses due to low subgrade, spread-

ing forms, etc., and from experience, it has been found that the following values should be assumed:

For concrete paving Coeff. = .88
Concrete in forms Coeff. = .85

These values may require slight adjustment from time to time due to difference in *complaisance* or other conditions. The yield should be checked carefully and adjustments made when necessary to keep the yield at exactly one cubic yard for each six sacks of cement.

Cement usually contains slightly less than 55 per cent voids, but for convenience the voids may be assumed to be 55 per cent. Voids in sand and coarse aggregate are to be determined as above. Following is an example of method of calculating yield:

Assumed mixture.

	Cu. ft. absolute volume
1 cubic foot (apparent volume) cement =	0.45
1.73 cubic feet (apparent volume) sand (voids 34%) = 1.73 X .66 =	1.14
3.82 cubic feet (apparent volume) coarse aggregate (voids 38%) = 3.82 X .62 =	2.37
Total absolute volume	3.96

$$\text{Cubic feet concrete per sack of cement} = \frac{3.96}{.88} = 4.50$$

Yield for six sacks = 4.50 X 6 = 27.00 cubic feet

These apparent volumes are *dry loose* measure. If material is measured wet, allowance in measuring must be made for swell.

In measuring batch boxes to set a mix, measure the sand as it comes from stock pile, but always correct for swell due to moisture content and in reports give cubic feet of both dry and wet material.

The following table gives yield of concrete with various percentages of voids in aggregate. The coefficient .88 is sufficiently high to provide concrete to fill irregularities in carefully constructed subgrade which has been struck to *full* depth with a template.

Where concrete is placed in forms and no extra volume need be provided for, the coefficient .88 may be reduced to .85.

After the mix is set in this manner, a careful check of cement and of the actual yield may sometimes require slight readjustment of the mix. Variations in voids in either sand or gravel will be immediately reflected by increasing or diminishing the yield of concrete.

Void determinations shall be made daily or more often if material shows variation.

CONCRETE PROPORTIONS

Six sacks per cubic yard

Sand* Voids	Rock Voids 35%	36%	37%	38%	39%
32	1-1.56-3.77	1-1.59-3.80	1-1.63-3.81	1-1.72-3.77	1-1.78-3.77
33	1-1.57-3.78	1-1.60-3.81	1-1.63-3.82	1-1.69-3.84	1-1.76-3.79
34	1-1.61-3.77	1-1.64-3.80	1-1.68-3.81	1-1.73-3.82	1-1.77-3.84
35	1-1.63-3.77	1-1.64-3.80	1-1.69-3.82	1-1.75-3.83	1-1.80-3.84
36	1-1.63-3.80	1-1.67-3.81	1-1.72-3.83	1-1.78-3.84	1-1.81-3.85
37	1-1.65-3.80	1-1.68-3.83	1-1.71-3.86	1-1.78-3.86	1-1.82-3.87
38	1-1.68-3.80	1-1.71-3.83	1-1.74-3.86	1-1.79-3.87	1-1.84-3.89
39	1-1.69-3.82	1-1.74-3.83	1-1.79-3.84	1-1.80-3.86	1-1.85-3.90
40	1-1.70-3.83	1-1.75-3.85	1-1.80-3.86	1-1.83-3.86	1-1.88-3.90
	40%	41%	42%	43%	44%
32	1-1.82-3.78	1-1.87-3.80	1-1.90-3.80	1-1.94-3.84	1-1.97-3.88
33	1-1.82-3.82	1-1.87-3.83	1-1.91-3.84	1-1.94-3.88	1-1.97-3.91
34	1-1.83-3.83	1-1.88-3.85	1-1.92-3.86	1-1.96-3.90	1-1.98-3.93
35	1-1.84-3.85	1-1.88-3.88	1-1.89-3.93	1-1.92-3.96	1-1.98-3.97
36	1-1.86-3.87	1-1.91-3.88	1-1.95-3.90	1-1.97-3.95	1-2-3.98
37	1-1.87-3.89	1-1.94-3.88	1-1.97-3.92	1-1.98-3.97	1-2-4
38	1-1.89-3.90	1-1.95-3.90	1-1.98-3.93	1-2-3.98	1-2-4
39	1-1.90-3.92	1-1.95-3.93	1-1.98-3.97	1-2-4	1-2-4
40	1-1.92-3.93	1-1.95-3.97	1-2-3.98	1-2-4	1-2-4

*Voids in loose material.

Colorado Highway Work in 1925

The work done by the Colorado State Highway Department during 1925 is briefly summed up by Roy J. Rawdall, office engineer of the department, as follows:

Federal Aid projects completed during the fiscal year which closed November 30, 1925, have totaled as follows: Ten concrete paved projects have added 28 miles to this type of construction within the state at a total cost of $1,145,954.79, and include 13 major structures. One asphalt paved project 2 miles long, cost $84,332.71. Eighteen surfaced projects (gravel or crushed stone) have added 93 miles to this type of road and the total cost was $1,137,826.71, including all major structures. Three graded projects, total length 3 miles, cost $139,045.39, including 4 major structures. Two projects consisting principally of bridges, cost $117,431.35.

The Federal Aid projects under construction but not yet completed at the end of the year are as follows:

Three concrete paved projects, total length 16½ miles and include 9 major structures. Twelve gravel surfaced projects, total length 54½ miles and include 8 major structures. Six graded projects, total length 68 miles and include 12 major structures. In addition to the above, there are 4 bridge projects under construction.

During the past year bids were opened in Denver on 20 different dates on 41 Federal Aid and State projects. That the bidding was keen is probably best shown by the fact that there was an average of eight bidders on each projects as compared with an average of about 5½ during 1924 and 1923.

The total estimated cost of the work involved as shown by the engineer's estimates was $2,915,453.80, as compared with $2,876,564.30 in 1924 and $2,316,853.52 in 1923. The total of the low bids is $2,482,204.14, or 85.14% of the engineer's estimates, as compared with 92.15% in 1924 and 91.18% in 1923. The total of the average of all bids received was $2,729,453.74 or 93.62% of the engineer's estimates as compared with 99.56% in 1924 and 101.03% in 1923.

The above figures indicate the very keen bidding had during the past year. About the middle of the year we discontinued showing contractors the engineer's estimate and with the somewhat paradoxical result that the bids were decidedly closer to the engineer's estimate when the bidders did not see it.

Foundations for New Orleans Pavements

A general, brief discussion of the subject of paved streets, with special reference to New Orleans, was the subject of a paper before the Louisiana Engineering Society by Bryson Vallas, city engineer of that city. Mr. Vallas referred to the necessity of widening many of the narrow streets of the city and other phases of the subject; but the points that received the most discussion had to do with foundation for pavements.

Said Mr. Vallas: "The greater part of New Orleans is about or below average lake level. The condition of the clay soil forming the sub-grade for pavement foundations is of almost constant saturation which has well entitled it to its local classification as mud." The only practicable remedy appears to be an elaborate system of sub-

surface drains laid several feet below the surface.

The removal of a large amount of ground water by these drains results in a settling of the ground. One street was cited where the drains had been laid three years before, and the sidewalk and curbs and gutter bottom, together with the buildings on the street, had settled from several inches to a foot or more.

There is no provision in the New Orleans law for laying and assessing the cost of these subsurface drains several years in advance of laying pavement on a street, but Mr. Vallas believed that much better results would be obtained if this could be done. The settlement of the ground due to this drainage is almost certain to be uneven, with a resultant cracking of the pavement slab and uneveness of the pavement surface. An effort has been made to minimize this undesirable result, in some cases by making thicker slabs and in others by reinforcement. Sufficient time has not elapsed to determine which of these is the better solution. In the case of the street above referred to, which had settled from several inches to a foot, steel reinforcement, about 50 pounds per 100 square feet, was used and the pavement slab has held its own and is today in good condition.

At the same meeting, Prof. John H. Batemen advocated using old gravel roads as a base for improved pavements rather than removing the gravel; and President Marcel Gersaud expressed his endorsement of the idea saying: "The idea of paving a street with gravel two feet above grade, and four or five years later to tear it up to get down to the original subgrade is wrong". The street should first be excavated to such a subgrade that the top of the gravel would be at the proper grade on which to rest a concrete or other hard-surface pavement when this is laid in the future. Another member also stated that in Louisiana, where natural foundations are none too good, the gravel road should be utilized to provide foundation for the higher type road of the future when increased travel and ample finances should justify it.

Cinder-Oil Roads in Great Falls

Great Falls, Montana, constructed 178,200 square yards of street paving last year using cinders and oil on the natural gumbo soil; the cost of this work being about $5,700 in addition to the oil.

The method of constructing this type of road, which has been developed by M. L. Morris, city engineer, is described by him for Public Works as follows.

"In constructing the oil-gumbo-cinder street, we do not undertake to put on cinders in quantities sufficient to make a wearing surface of them, having found by experience that cinders alone will corrugate under traffic just as gravel will and the absorptive quality of cinders alone is so great that oil, if applied to keep down the dust, must be used in excessive quantities. For the above reasons it is apparent that a pure cinder road is not desirable.

"Having reached the above conclusions, it seemed logical to attempt the improvement of the bearing quality of the soil itself. This was done by placing cinders upon the roadway in small quantities and spreading them by the use of a road grader. This being done, the road was scarified the full width and this was followed by the sprinkling tank keeping the mass thorough damp during the time of processing. Processing was accomplished by passing the material, by means of the road grader, from the center to the sides, and from the sides back to the center, and repeating this operation until the surface road material showed a uniform mixture. After this, the road was placed in the shape desired with the grader and left to be solidified under traffic. In order that the road, when thoroughly packed, might be of even and smooth contour a two-horse drag was kept going.

After the road had become smooth and solid it received a light application of oil. Subsequently oil was added in light applications as soon as excess oil had evaporated, until the condition of the road surface had become that which was desired."

The low cost of about 3½ cents per square yard was made possible by the fact that hauling of the cinders to the road was a very small item, first, because no very great quantity of cinders was used and second, because the cinders were placed upon the streets by men who had cinder contracts with the business blocks of the city and were paid only a nominal price to dump the cinders where wanted on the streets. This they are very glad to do, since the cinder hauler then gets something for his load and is relieved of the long run to the dump which he would otherwise have to make.

Electric Pumps at South Bend

The municipal waterworks pumping station at South Bend, Ind., uses two plunger pumps direct connected to cross compound condensing engines for pumping water directly from wells and two centrifugal steam engine driven pumps pumping water from wells to the 6-million-gallon storage reservoir. Up to a year ago water was pumped from the reservoir to the mains by two steam pumps, but these had worn out and were then replaced by a 480 h.p. General Electric steam turbine driving a centrifugal pump through herringbone gear. The engine-driven centrifugal pumps refill the reservoir during the night. The turbine driven pump is operated only on peak load in the afternoons, and, during the nine colder months of the year, was operated 8 hours a month. The total number of running hours was only 252, but in spite of this the fixed charges per hour are but $13.68 and the cost per thousand gallons of water pumped 4.13 cents. The steam cost is 1.33 cents per thousand gallons of water, making a total cost of 5½ cents per thousand gallons pumped for depreciation, interest, lubricating oil, steam, and allowance for maintenance and repairs. With the former steam pumps there was a steam consumption of 31,200 pounds per hour as against 8,160 pounds with the turbine

driven pump. The difference, at an estimated cost of 55 cents per thousand pounds of steam, shows a saving of $3,193 during the year, which practically equals the fixed charges and operating expenses of the turbine installation.

Governing Factors in Selection of Durable Types of City Pavements*

By C. M. Pinckney†

While the paving problem of New York City is very much like that of other great cities, there are a few conditions there that should be understood. The Borough of Manhattan—the old city of New York—is situated on a long, narrow island surrounded on all sides by some ninety communities, which cover an area of about 700 square miles, with a population of about 15,000,000 people. Of this great area and population, Manhattan is the business and recreation center and consequently all roads lead to Manhattan.

Because of its long, narrow shape, entirely surrounded by water, the great mass of traffic, amounting to nearly 300,000 vehicles per day, moves up and down long parallel avenues, some of which are 13 miles long, through the most densly populated territory.

A count of traffic entering and leaving the island made last May shows that 99,441 vehicles came into Manhattan and that 96,219 left Manhattan in 12 daylight hours. Conservatively estimating, another 150,000 vehicles, stable and garage, in Manhattan can use the streets day and night.

ECONOMY IN PAVING

In the selection of pavements for a city like Manhattan the pavement best suited to the traffic it is to sustain will prove the most economical one to lay, regardless of the first cost, and such a pavement will render the most satisfactory service to the public.

No quality which a pavement can possess is more important than smoothness without slipperiness.

The financial gain through well selected, durable pavements will be reflected in traffic relief by keeping streets free, open and in good condition —the reduction in tractive effort required to move merchandise alone will pay for the proper pavement—the wear and tear on vehicles, man and beast will be reduced if the pavement is carefully selected.

Pavements are not temporary. The city must provide and maintain a pavement on every street for the health and economic welfare of the community and the condition of a city's pavements is a fair gauge of its civilization.

*Paper read before the American Road Builders Association.

†Chief engineer, Borough of Manhattan, New York.

SELECTION OF TYPE

The use to which the pavement is to be put is the real governing factor in its selection. It must sustain the impact from loads of at least 800 lbs. per inch width of tire on each and every wheel traveling at a speed of 15 miles per hour.

It must resist the wear and tear from skid chains and tire suction.

It must provide traction for starting and stopping promptly, and must be as nearly skid-proof as practicable.

If the street to be paved is residential, or fronts upon a hospital, school, court, library or office building, quiet is essential. If it is occupied for manufacturing, freight terminals, markets, quiet is not so essential. Where traffic is on rubber, quiet is not a controlling factor, although it is desirable.

The grade limits the type according to the tractive resistance it provides.

A wide street provides leeway in the selection, as greater distribution means better service from the pavement and longer life.

The climatic conditions under which a pavement is used is a factor, as the contraction and expansion of the materials entering into the pavement have certain limitations. A pavement that cracks in the winter and becomes soft in the summer is not durable. A pavement which is not impervious to water is not durable.

A city pavement must be of such a type that it can be laid and opened to traffic as rapidly as possible. The minute it is completed, the public demands that it be turned over to them for use. The closing of one block in a built-up city means congestion in all adjoining streets, with its consequent loss of business, fire hazard and general inconvenience.

A city pavement must be of a type capable of quick repair, permanent repair and easily cleaned.

It should resist, as far as practicable, the destructive effect of illuminating gas, gasoline, oil, steam and fire.

Do not select a pavement which you have no facilities to maintain. The salvage value of the old pavement is a factor worth while considering.

GUARANTEES

Long maintenance guarantees are to be avoided. You pay for them and it is doubtful if you receive the benefits. It is exceptional for a guarantor to make a repair or restoration within the contract time allowed, and the repair is usually made when the amount of repair has accrued to the extent of a day's work. In a city, 48 hours is a long time to allow a major defect to exist in a street where 10,000 vehicles have to dodge the same or plunge into it.

FIRST COST

The first cost of city pavements usually staggers the engineer. Don't let the first cost take precedence over ultimate economy. There can be no greater fallacy than that cheapness in pavements means economy. Spreading pavements over as great an area as possible is false economy.

FOUNDATION

The best wearing surface ever designed or selected has no greater value than the foundation upon which it rests.

In the Borough of Manhattan, the traffic loads, speed and volume have demonstrated beyond any question of doubt that the heavier the foundation and the more substantial, the better the pavement. Except on a purely residential street—no foundation, no matter what the character of its material may be, should be less than 9 inches. To be on the safe side, main traffic arteries in a city like New York should have a concrete foundation 12 inches or more. On the marginal streets along the river front, 12 inches of reinforced concrete appears to be necessary.

GENERAL

Habit of selection is not wise selection. Keep informed through the many channels open to you, of what the world is doing in paving and the exact type you are seeking will be found to fit your requirements to the letter. A knowledge of all types of paving is one of the first essentials to the selection of an engineer, as well as the payment.

Assume that you have gauged the traffic to be carried by the pavement—that you have decided whether quiet is essential—that you have considered the grade and width of the street—that you have made sure you can take care of the pavement after you lay it; then lay the best of the type you have selected.

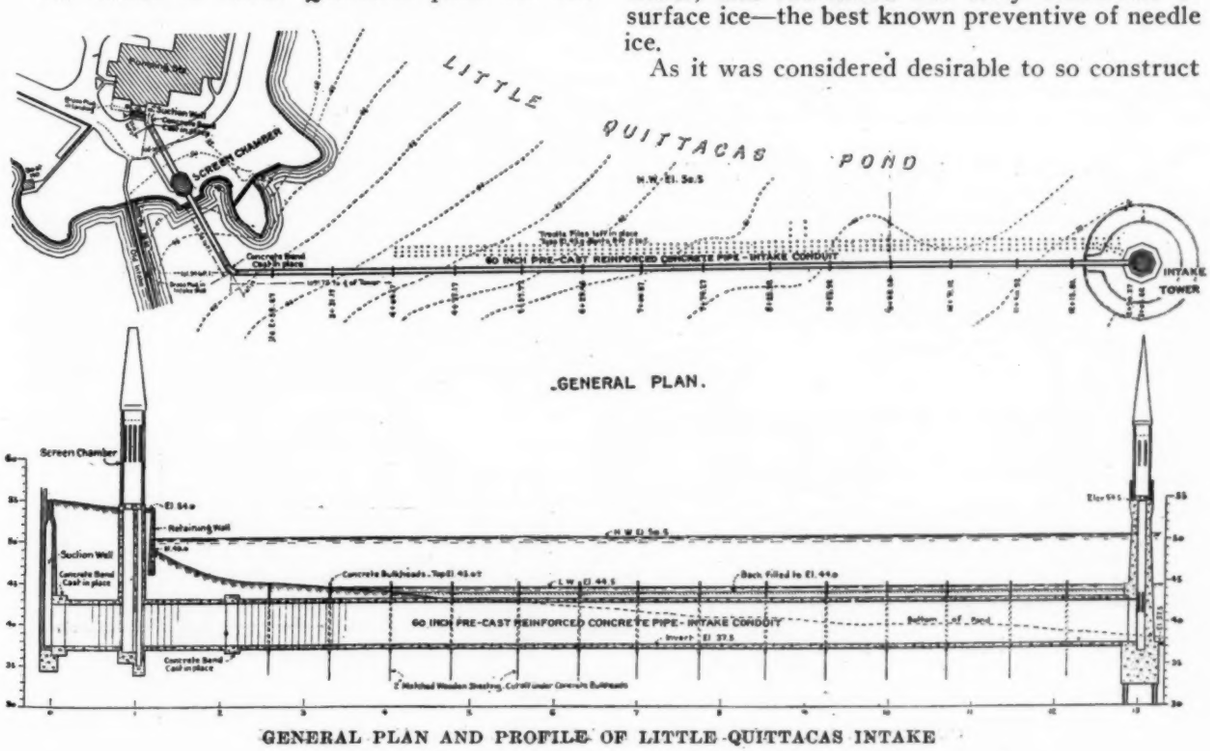
New Intake At New Bedford

Sixty-inch precast reinforced concrete pipe, weighted with additional concrete to overcome buoyancy. Mechanically operated belt screen. Intake tower designed to resist ice pressure. Plan adopted for laying intake conduit.

A new intake in Little Quittacas pond, constructed for the New Bedford, Massachusetts, water department, was described before the New England Waterworks' Association by F. A. Barbour, who, with Stephen H. Taylor, superintendent of that department, were jointly responsible for the design. Both design and method of construction contain a number of interesting features, and the principal points are taken from the paper in the following abstract.

An intake in Little Quittacas pond for the waterworks had been built in 1896 to 1899. Because it is the policy of the department to construct in duplicate all of the essential features of the plant, and because considerable trouble had been experienced with clogging of screens by frazil ice, it was decided to construct a new intake. The location of this was selected with a view to preventing frazil or needle ice as far as possible, a point being selected under the lee shore which protected the water from northerly winds, and facilitated the early formation of surface ice—the best known preventive of needle ice.

As it was considered desirable to so construct



GENERAL PLAN AND PROFILE OF LITTLE QUITTACAS INTAKE

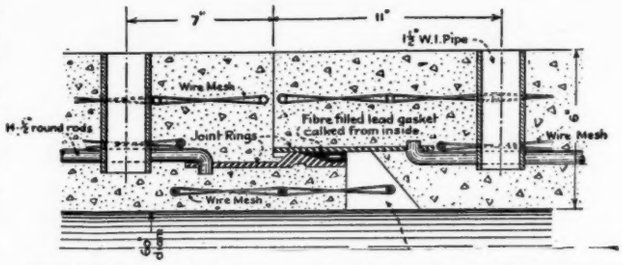
the new intake as to permit unwatering of the conduit for inspection, cleaning and repairs, an intake tower was constructed at the outer end and a screen chamber on shore near the pumping station. Sixty inches was chosen as the diameter of the conduit which, it was calculated, would pass 35 million gallons per day with an available head of 1.5 feet after allowing for friction through intake ports, screen and conduit and a four-foot submergence of the suction pipes in the pump well. This amount is fifty per cent. greater than the anticipated average consumption rate in 1950.

The desire for unwatering the pipe made it necessary to provide against the flotation of the conduit, which necessitated adding weight to its entire length at a cost of about $50,000.

The line of the new conduit extends north from the pumping station 220 feet and then northwest for 1,080 feet to the intake tower; this broken alignment being selected to avoid deep rock cutting and also to leave as quickly as possible the station foundations, which were reported to have been in quicksand. (As a matter of fact, practically no difficulty was encountered in laying the conduit in the vicinity of the pumping station). A screen chamber was located about 80 feet from the station.

The elevation of the conduit was such as to place it on solid bottom at the outer end and bring the top one foot below the minimum level of the pond when drawn down. Concrete was selected for the conduit, as cast iron at that time cost $65 per ton, and would make it cost about 75 per cent. more than concrete. Bids were received on both precast concrete pipe and concrete poured in place. The lowest bid for the former exceeded by $9,000 the lowest for poured-in-place conduit, but it was believed that better pipe can be cast in vertical forms on dry ground than horizontally in a trench with a bottom that might contain boils, and it was decided to award the contract to the lowest bidder for laying precast pipe.

The pipe used was purchased directly by the department from the Lock Joint Pipe Company at $18 per lineal foot for 60-inch pipe, $4.50 per lead gasket and $4.00 for tie bolts for each joint. The pipes were made in 8-foot lengths, 6 inches thick, with joints of the type shown in the illustration formed of galvanized steel rings designed for use of a made-up lead gasket to be caulked from the inside. The pipes were reinforced with a double cage of wire mesh and the concrete was mixed 1 cement, 1½ sand, and 2½ aggregate ranging from ¼ inch to ¾ inch in size. Near each end of each pipe two 1½-inch nipples were set on a diametrical line for the insertion of eye-bars through which to pass the tie bolts used in drawing the pipes together. It was specified that the leakage under 10 pounds pressure made on two lengths of pipe jointed together and bulk-headed, should not exceed a rate of 100 gallons per mile per 24 hours. The test showed approximately two-thirds of this leakage, practically all of which came through the concrete and not through the joint and gradually lessened as the water was held in the pipes.

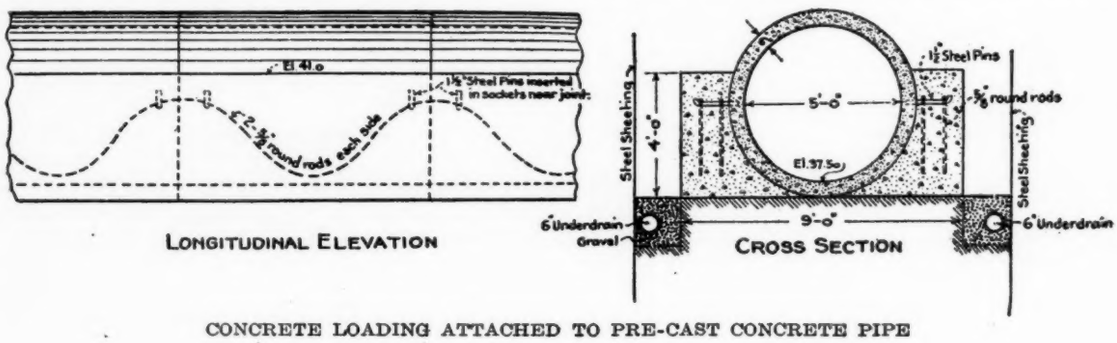


DETAILS OF JOINT OF PRE-CAST CONCRETE PIPE

As the pipe weighed 1,210 pounds per lineal foot and the displaced water 1,770 pounds, there was a net buoyancy of 560 pounds per lineal foot to be overcome, and to effect this, the lower two-thirds of the pipe was encased in concrete sufficient to give a total weight of 680 pounds per lineal foot in excess of the buoyancy. This additional concrete was anchored to the pipe by means of a steel pin 1½ inches diameter set into each of the four nipple-lined holes previously referred to and projecting 12 inches into the anchor concrete, while over these pins, two lines of ⅝-inch reinforcing rods were draped; both pins and rods being imbedded in the anchor concrete.

SCREEN CHAMBER AND SCREEN

The screen chamber is divided into two compartments, one forming a pump sump, to facilitate draining the conduit; the second, a chamber holding a mechanically operated screen. The department had for fifteen years used a belt type screen which had given satisfactory results, and for the new plant bids were received for a motor driven screen of the same type complete, including a frame truss for supporting the tackle necessary in erection or dismantling; the Link-Belt Company being awarded the contract at $2,800.



CONCRETE LOADING ATTACHED TO PRE-CAST CONCRETE PIPE

The screen consists of a structural steel framework carrying head and foot sprockets over which runs on either side a double link, 24 inch pitch, bronze-bushed steel roller chain, to each inside link of which there is attached a screen panel frame of 2 in. x 2 in. x 3/16 in. steel angles carrying copper wire cloth. The specifications required the cloth to be No. 12 B & S gauge copper wire mesh with ¼ inch clear spaces. There are also spray pipes, splash plate, and drip opening; while mounted on the top of the main frame is a 3-phase, 220 volt, 1,760 r. p. m. motor, driving the screen at a speed of 10½ feet per minute. "The outstanding features in the design of the Link-Belt company's screen are the steel angle panel frames and the inward slope of the down run of panels at the point of spraying. Because of the use of steel angle panel frames, a wider screen must be provided for the same net area of screen cloth than where flat plate frames are used." The power required to operate the screen when clean is 1.12 k. w. The water discharged by the two lines of 2-inch spray pipes, perforated with ⅛ inch holes, ⅝ inch on centers, amounts to about 100 g. p. m. under 20 pounds pressure, which appears to be sufficient for effectively cleaning the screen. Figuring the electricity at 5 cents per k. w. h. and the water at $15 per million gallons, the total cost of operating the screen would be somewhat less than 20 cents per hour. The screen can be started either from a switch in the screen house or from the pumping station. Provision was made for applying steam in case of clogging by anchor ice, by laying an insulated pipe in the conduit from the pumping station.

THE INTAKE TOWER

Special pains were taken to so construct the intake tower that it would resist any possible ice thrust. For this reason the vertical projection at the level of the ice was made as small as was possible while providing an area of ports sufficient to reduce the inlet velocity of the water to the rate of 3 or 4 inches per second. The tower rests on an octagonal slab 42 feet wide and 5 feet thick. The superstructure is an octagonal reinforced concrete tower, 30 feet wide between parallel faces at the foundation and 21 feet 6 inches at the elevation of high water, giving a batter of 1 horizontal to 3 vertical. The design was based on assumed ice thrust of 22,500 pounds per foot of width of projection at a point 6 inches below the level of full pond, together with a wind load of 20 pounds per square foot, the weight being calculated to bring the resultant within the middle third of the foundation. Mr. Barbour believed that the assumed ice thrust was greater than would ever be realized, as the ice would probably buckle or slide up on the shore or up the batter of the tower before this amount of pressure would be obtained.

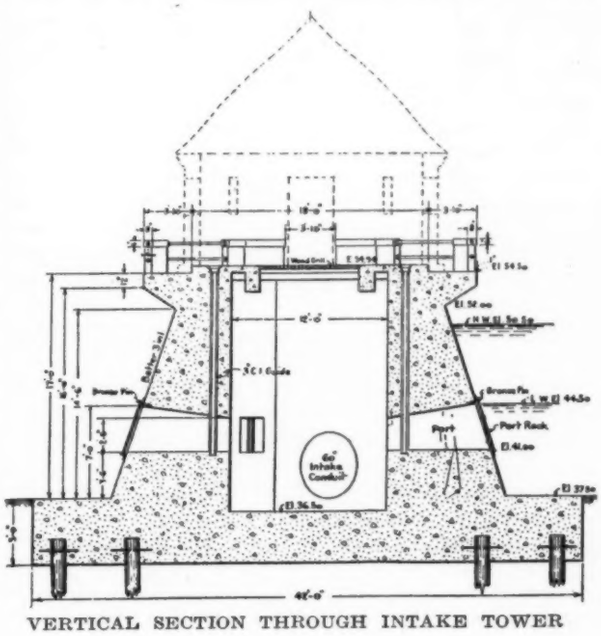
In six of the eight faces of the tower were placed ports 5.0 feet by 3.5 feet on the outside reducing to 2.5 feet at the vertical inner face. This gives a total port area on the outer face of 5 1/3 times the area of the conduit, and an inlet velocity of 4½ inches per second when entering at the rate of 25 million gallons per day. Provision is made for closing the ports by stop planks in case it is desired to inspect the interior of the tower.

CONTRACT PRICES

The contract price for furnishing the 60-inch precast pipe by the Lock Joint Pipe Company was $23,372. The work of constructing the intake, exclusive of cost of pipe, was awarded to R. H. Beattie Company of Fall River for $153,655, the bids being received on unit prices for excavation, laying, concrete masonry, etc. The cost of the completed work was $206,773, which was $3,227 less than the estimate made by Mr. Taylor and Mr. Barbour in their preliminary report. However, the contractor's record shows a loss on the job of about $20,000, a great part of which was explained by the small salvage in steel sheeting and trestle timber, expense and disorganization resulting from accidents to a locomotive crane, and particularly by the always uneconomical night work undertaken in trying to complete the contract within the specified time.

CONSTRUCTION FEATURES

The general plan of work adopted by the contractor for laying the conduit was to construct a temporary pile trestle parallel to the pipe line, the nearest piles being 18 feet from the center of the conduit; which trestle carried a standard gauge track, over which was transported from the shore all the material needed in the work; the trestle also carrying a pile driver and locomotive crane used in driving and pulling piles, handling pipe, etc. The concrete mixing plant was located on the shore and the concrete for the pipe anchorage was carried from here to the conduit over the trestle. A pile driver frame rigged with a boom and skidded along the trestle was largely used in placing the steel sheeting and in suspending the steam hammer used in driving it. This was a Union hammer weighing 1,400



VERTICAL SECTION THROUGH INTAKE TOWER

pounds, the ram weighing 214 pounds and delivering 200 blows per minute. The moving of material was performed by a 30-ton Ohio steam driven locomotive crane with a rotary upper frame.

In laying the pipe, a cofferdam was constructed by driving Lackawanna straight-web, 40-pound steel sheeting 24-feet long and driven from 7 to 20 feet below the bottom of the conduit. In laying in water, the general method involved the following routine: First, driving two lines of sheeting enclosing a 72-foot length of trench; second, moving ahead the pumps and unwatering this section; third, excavating this section and removing the last preceding bulkhead of steel sheeting; fourth, filling with screened gravel the pump well of the previous section and excavating a similar pump well on the further end of the new section by driving a cross line of wooden sheeting about 4 feet back of the outboard steel bulkhead; also driving a transverse double line of 2″x6″ hard pine sheeting carried from 4 to 6 feet below grade, about 4 feet back of the pump well, to prevent undermining the pipe foundations; fifth, laying a line of 6-inch tile drain surrounded by screened gravel on either side of the trench close to the sheeting and leading it to the forward pump well; also placing 4″x12″ hard pine sills across the trench 4 feet apart to carry the pipe; sixth, placing the pipe on the cross sills and making up the joints; seventh, setting the panel forms for pouring the loading concrete, and placing this concrete.

Four feet back of the bell-end of the last pipe laid in the previous section, and directly over the wooden sheet piling referred to, a bulkhead of concrete was poured under and around the pipe, carried the full width of the trench and up to a level 6 inches above the water in the pond, which bulkhead kept out the pond water and permitted backfilling to be placed. The underdrains were plugged at this concrete bulkhead, this limiting the water to be pumped at any one time to the seepage in a 72-foot length of trench. Another gang was continuously engaged in pulling sheeting from the next to the last preceding section and driving it for the next section ahead.

The bottom of the pond was of compact sand ranging from very fine to moderately coarse and containing in some places considerable silt and clay. The steel sheeting was surprisingly tight, two 4-inch pulsometers being at times sufficient to remove the inflow after the original dewatering; although where the bottom material was coarse, the leakage was sufficient to require two 6-inch centrifugals in addition. Boils and uplift in the bottom occurred only where the material was fine and compact and the amount of seepage small. At certain points it would have been impossible or at least extremely difficult to build a satisfactory poured-in-place conduit, and the decision to use precast pipe was considered to have been fortunate. After the pipe was laid, two men were constantly engaged in caulking the joints from the inside, filling the recess with mortar and rubbing the surface flush and smooth with carborundum blocks.

Slag Concrete on Alabama Road

Special construction details adapted to the use of slag, including keeping it wet before mixing. Belt finishing impossible.

In 1924, the Alabama Highway Commission decided to pave a portion of state highway number 46, south of Jacksonville, with an 18-foot concrete slab, the traffic here being quite heavy. A total of 23 miles of this highway was to be improved, but the county's share of the state bond issue would not permit using concrete on the balance, and macadam was decided upon. Property owners in the county, however, were so opposed to this that an agreement was finally made whereby the balance of the road would be paved with concrete instead of macadam, the county paying one-half the cost thereof. Also, the town of Oxford, the city of Anniston and other communities, learning that the county highway would be improved through their limits by an 18-foot strip, at their own expense widened this so as to give concrete pavement full width from curb to curb through a part at least of the municipality. Most of this road was built in 1925.

In the construction, washed sand from Montgomery was used as fine aggregate and basic blast furnace slag from Birmingham as coarse aggregate. The construction method adopted was to proportion the materials at a central plant and haul them to two Smith mixers, using a fleet of 40 Ford trucks. As the state specifications prohibit hauling cement in bulk, six sacks of cement were laid upon the aggregate in the truck, to be dumped into the hopper when the aggregate was placed there. The proportioning plant was set up at three locations which were so well selected that the average haul on the 23 miles of work was only 3 miles.

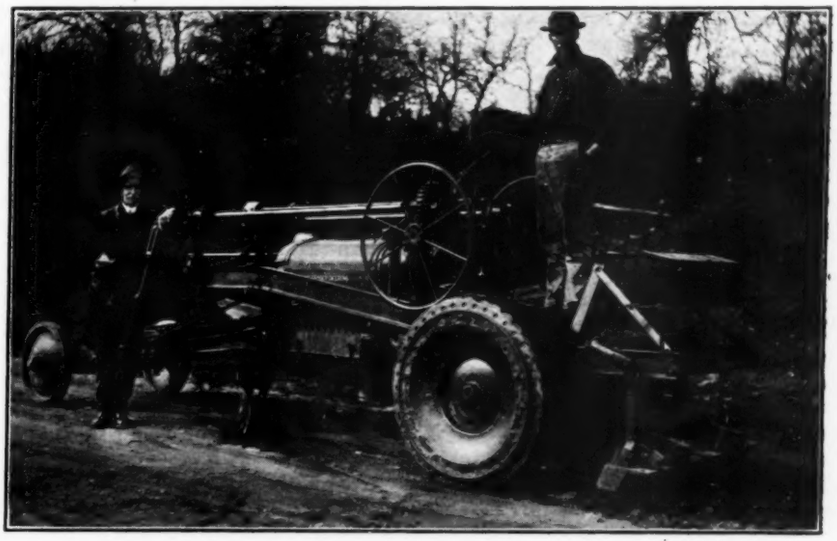
One of the interesting features of this work was the special method employed because of the use of slag. Birmingham slag weighs about 80 pounds per cubic foot and has French coefficient of from 5 to 6. It contains a large number of pores varying from those left by minute air bubbles to larger ones like the cells of fine honeycomb. It therefore absorbs moisture readily and if used dry would abstract much of it from the mixed concrete. To prevent this, the coarse aggregate bin was supplied with perforated water pipes which sprayed the slag and kept the pores filled with moisture.

When slag concrete has been placed in the pavement there are always a few very light pieces which float to the surface and which cannot be submerged by the finishing apparatus, but must be picked from the surface by hand. The edges of pieces of slag are usually sharp and will catch upon belts and cause the slag to roll. This is prevented by removing the belt from the finishing machine and following the

mechanical striking and tamping with a longitudinal float operated by two men from bridges which span the pavement. Following this, excess water is worked to the side of the slab by means of a long-handled metal roller, which also submerges pieces of slag floating on the surface. When the concrete has stiffened a little, a bow belt gives the surface its final finish.

The Southern Testing Laboratory had an inspector continually on duty at the proportioning plant, who each day made a sieve analysis to determine the fineness modulus of both fine and coarse aggregate; that of the sand averaging about 2.80 and of the slag 7.31, with very little variation from these averages. A road inspector made slump tests at frequent intervals and once a day cast a 6x12 inch concrete cylinder to be tested by compession at the laboratory. It required about 5½ gallons of mixing water to secure a slump of from one-half to one inch. Materials were measured by volume, allowance being made for about 1.3 percent of bulking of sand due to 3½ to 5 percent moisture. Moisture does not cause slag to bulk.

The cross section of the slab was a slight modification of the so-called "Illinois" type, the edges being 9 inches thick, decreasing in 3 feet to a uniform thickness to 6 inches. Expansion joints were placed at 40-foot intervals.



GRADE MAINTAINER OF THE CALIFORNIA HIGHWAY COMMISSION

California Grader-Maintainers

The California State Highway Commission has in operation about fifty grader-maintainers used in maintaining dirt and gravel roads and gravel shoulders on the state highways. The special feature of this machine is a 15-tooth scarifier at the rear of the machine, the purpose of which is to break up corrugations in dirt and gravel roads. The teeth can be set at any desired elevation. The mould board is especially designed and located to eliminate skidding or side swiping of the grader and to give the greatest possible roll and scour of the loose material which it carries with it. Division superintendents state that it is quite feasible to cover from 30 to 35 miles of dirt or gravel highway per day with this maintainer, in many cases pulling a 7-foot or 8-foot drag in addition to the 8-foot blade of the grader.

Substitute for Slump Test

Footprints of the concrete puddlers as a test of the consistency of concrete was used in the construction of the Wilson Dam, the desired consistency being such that the rubber boots of a puddler (weight not stated) would sink two inches into the concrete in place, and in no case more than ten inches. This statement was made at a recent meeting of the American Concrete Institute in Chicago and caused some amusement. Such a test is a "field test" which may have its value. It might even be made more or less exact by specifying the weight of man per square inch area of sole of boot; or by substituting a rammer weighted to give a specified pressure per square inch, the penetration in a given number of minutes to lie between certain fixed limits.

Road Construction in The Far East

Notes on conditions in India, British Malaya, the East Indies, China, Japan and Chosen

Under this heading "Commerce Reports," the weekly publication of the U. S. Department of Commerce, presented a series of notes, prepared by Frank D. Curran, of the Transportation Division of the Department, giving information concerning road construction in India, British Malaya, the East Indies, China, Japan and Chosen.

American exporters of automotive and road construction machinery and material have to meet competition in these colonial territories, preference naturally being given to the firms of the ruling country. Aside from this, a firm with a representative on the ground has a great advantage over his competitors.

The cost of labor and the purchasing power of the people in these countries is very much less than in the United States. Also the Oriental, with the exception of the Japanese, is inherently conservative.

Road construction in the Orient means generally the improvement of an old route through

territory already well developed commercially. Below are given abstracts from the road construction notes of Mr. Curran.

The outlook for road improvement in India in 1926 is not so bright as in some other countries; largely because funds are not available for more than a small part of the work which is really necessary. The historic Grand Trunk road, the most important highway in the country, is being modernized as rapidly as funds permit. The minimum width of metal is 12 feet; minimum clear width of roadway over bridges, 15 feet; sharpest curve 35 feet radius at center of road, sharp curves being banked; the maximum gradient is one in 10; the average camber of metal surface is 1 to 66. Bridges are capable of carrying a 12-ton road roller. In the United Provinces of India, the width of metal is often 14 to 16 feet and in parts of the Punjab it is 14 to 18 feet. The metaling consists generally of waterbound macadam in which local stone is generally used.

Where cost of maintenance has become excessive, the engineers are using tars and asphalts, and in large cities where traffic is very heavy, bituminous pavements are laid in accordance with American and British practice. Because of the high temperature, the heavier native asphalts are favored. Cement concrete has been used occasionally for roadways over bridges and in other locations. Considerable interest has been shown during the past year in the use of asphalt for the main thorofares of Mysore.

It is planned to spend about $1,830,000 in road improvements in Calcutta and environs, to be raised by 6 percent 30-year bonds. The Punjab has about 25,000 miles of roads, of which over 3000 are metaled. A scheme adopted by the Department of Public Works calls for an arterial system of first class roads to penetrate the whole province. These are to be a provincial charge, and include 500 miles of metaled and 1500 miles of unmetaled roads.

British Malaya has an excellent and well maintained system of paved highways which was materially increased during 1925. An extensive program for straightening curves was adopted last year and is gradually being carried out. Road dressings are being studied as to their sun-proof and water-proof qualities, and in the cities, a type of pavement is being developed which appears to be resistant not only to climatic conditions, but also to heavy cart and truck traffic.

Three kinds of road construction work have been carried on: one, already used for surfacing 5½ million to 7 million square yards, consists of covering old gravel or chat roads with bitumen applied hot and covered with sand or stone chips. In the second, crushed stone is placed on top and bitumen applied by the penetration method. The third is the use of bituminous concrete. In Penang, one American and one British firm some months ago were allotted certain heavy-traffic streets to test out the third type of construction.

In Java a well-devised plan for a system of connected roads was put in effect in 1912, involving an expenditure of about 3½ million dollars, of which more than one-fourth remains as yet unspent. At the same time, local plans were authorized to cost about 14 million dollars, almost half of which have been carried out. Asphalt is the most popular material and has almost completely superseded other materials since American companies introduced it several years ago. The Batavia municipality has recently prepared a comprehensive road plan requiring a large amount of asphalt, a contract for which will probably be given to one of the two American companies on the ground. "There will be no opportunity for the sale of road building machinery."

In the island of Sumatra, road building is more difficult and improvements are planned costing 24 million dollars, of which less than half has been spent. In Borneo, about $8,640,000 worth of road work has been planned, the greater part of which has yet to be done. In the Celebes, roads have been planned to cost over 4 million dollars, about half of which has been spent.

Potentially, China offers a splendid field for highway construction work, but there is little opportunity in the near future. Many short roads have been constructed, but none of a permanent type. There is little opportunity for foreign investment or construction so long as the present unsettled conditions prevail.

Japan's roads suffered greatly from the earthquake of 1923, but extensive repairs have already been made. A general plan for the reconstruction and improvement of roads has been approved by the Home Office, the scheme involving a total cost of nearly 70 million dollars, of which the national treasury will provide about 23 millions. It is planned to spread the work over 10 years, spending about $1,300,000 the first year. The total length of roads in this project is 4,880 miles, the average width 24 feet, increased to 33 or 36 feet in urban districts. The road through the Hakone Mountains, connecting eastern and western Japan, was completely destroyed by the earthquake but has been rebuilt. A branch of this road will be completed as a military road this year. The great road from Tokio to Yokohoma also will be finished this year, giving a traveling time of 25 minutes between the two cities. The Imperial avenue in Tokio, to connect the station with the Imperial palace, will be completed within a few months with a width of 72 meters, 22 meters reserved for motor traffic, at a cost of about $432,000. A new 90-foot highway with an inter-urban trolley line in the center connecting Kobe with Osaka will be finished by November of this year.

Chosen, since the beginning of the first Japanese protectorate, has built over 5,000 miles of first-class and second-class roads and about 4300 miles of third class. In addition to this, street improvements costing about one and a half million dollars are projected for Keijo, and eight other cities are to have new streets.

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CONTENTS

SEWAGE WORKS APPURTENANCES. Illustrated. By C. E. Keefer 75
LIMESTONE FOR SEWAGE TRICKLING FILTERS. By T. C. Schaetzle 77
A MUNICIPAL TOURIST CAMP IN FLORIDA. Illustrated. By E. L. Filby 78
HOG FEEDING AT FLINT, MICH. By Nahum W. Long 81
BUILDING CALIFORNIA CONCRETE ROADS.. 82
Colorado Highway Work in 1925 84
Foundations for New Orleans Pavements 84
Cinder-Oil Roads in Great Falls 85
Electric Pumps at South Bend 85
GOVERNING FACTORS IN SELECTION OF DURABLE TYPES OF CITY PAVEMENTS. By C. M. Pinckney 86
NEW INTAKE AT NEW BEDFORD. Illustrated.. 87
SLAG CONCRETE ON ALABAMA ROAD 90
California Grader-Maintainers. Illustrated 91
Substitute for Slump Test 91
ROAD CONSTRUCTION IN THE FAR EAST 91
EDITORIAL NOTES: 93
Appearance Counts—Tourist Camps
TRAFFIC COUNTS IN COLORADO 94
STREAM POLLUTION AND OXYGEN BALANCE. Illustrated 95
RESURFACING IN WABASH COUNTY 99
BOND BETWEEN CONCRETE AND STEEL 100
CURING CONCRETE ROADS WITH SILICATE OF SODA. Illustrated. By R. F. Remler 101
USE OF TRENCHING MACHINERY BY WATER DEPARTMENTS. By Thomas Brooks and Stephen H. Taylor 103
Maintaining Washington's Gravel Roads 105
The Liberal Professions 106
Concrete Crib Retaining Wall. Illustrated 106
RECENT DEVELOPMENTS IN BITUMINOUS PAVING PRACTICE 107
Taxing Parking Privileges 108
RECENT DEVELOPMENTS IN CONCRETE PAVING PRACTICE 108
A Writer's Description of a Steam Shovel 109
Snow Fall on New Mexico's Roads 109
CITY PAVING DONE IN 1925. Tables 110
Used for Laying Dust 113
Quick Hardening Cements 114
America's Highest Head Power Plant 114
Asphaltic Roadway Surfacing 114
RECENT LEGAL DECISIONS 115

Appearance Counts

It has been stated that the most important step taken in this country toward improving street cleaning service was putting New York's street cleaners into uniforms; it showed them that the work they did was considered of some importance and dignity, and served as a basis for an esprit de corps.

Too often sewage and garbage disposal plants, after being constructed in some out-of-the-way part of the city or its environs, are at once put out of the minds of the officials as necessarily offensive spots because dealing with offensive matters. Besides, why waste money and thought on cleanliness and beauty when no citizen would ever visit such a place?

The answer to this argument is suggested by the "White Wings" unform—by giving an attractive appearance to such structures and their surroundings and by insisting that they be kept clean and neat, the attendants will react psychologically and take an interest in the efficient operation of the plant; and it will be possible to employ a higher grade of man to operate the plant. Moreover, it is found that such plants can be made so inoffensive and even attractive in appearance that citizens will visit them and, taking an interest in them, will insist upon efficiency and economy in their operation.

We have described several plants of this kind which have been rendered attractive by the planting of vines and shrubbery and grading and providing walks and drives; or, in some cases of small plants, by housing them completely in sightly buildings and keeping the whole interior of the building clean and odorless.

An instance of attention to appearance and also to details that make for convenience and economy of operation is described in the first article in this issue. While few cities have plants as large as Baltimore's, or would need to consider underground wire conduits and transformer buildings or telephone systems, even the smallest should employ trees and shrubbery, construct walks and a driveway, and use as ornamental street lights and standards and poles for supporting wires as are used on the city's streets.

Tourist Camps

Eugene Sue years ago used as the basis of his novel, "The Wandering Jew," an old legend of a man who was condemned to wander endlessly over the world and who, wherever he went, carried pestilence. (Typhoid Mary had not been born or even imagined then.) Today such a man would be discovered and either cured or confined—or such is our theory.

Wandering, no longer confined to a few, has become the pleasure of millions and the mania of thousands, and hardly a nook or corner of this country but is reached by the automobile tourist. Given a few plague carriers among these, and the harm that they could do would be limitless. Typhoid, smallpox and all other infectious diseases might be spread to every part of the country.

It is therefore even more important that such diseases be prevented in those who tour, than in

those who remain at home under the eye of the family physician and city health officer. And the only place where many of these can be observed, and the one where they are most likely to receive or give infection, is the tourist camp. It is apparent, therefore, how important it is that such camps be so constructed, equipped and managed as to reduce to a minimum danger of communication of disease from one occupant to others.

This is generally realized by most state and many local health authorities. Just at present Florida has this problem presented to it to a more intense degree than any other state; and what one city, cooperating with the state health authorities, has done and is doing is told in this issue. Not only is the sanitary removal of sewage and garbage provided for, and safe drinking water, but washing of clothing and person; dry, airy rooms, screened against disease-carrying flies and mosquitoes, are furnished; also facilities for rest and amusement which aid the body to keep fit, and for obtaining good food that should furnish healthy vigor to discourage any disease germs lurking around looking for a host.

Traffic Counts in Colorado

Results of a traffic census taken by the Colorado State Highway Department.

By J. E. Furlong*

Upon the approval of the 1923 budget there became available a fund making possible a study of the traffic using our highways throughout the state, known as the Traffic Census.

This was deemed necessary, as it could be seen even by the casual observer that the volume, speed and weight of vehicles using the highways were increasing, by leaps and bounds, and as yet there were no data showing what was expected of the various routes, structures and pavements.

The value of such a study may be seen when the following reasons for it are considered:

1. To classify the various highways in regard to density of traffic thereon.

2. To determine the hourly, daily, weekly, monthly and yearly density and variation of traffic.

The methods employed consist of the actual counting and classification of vehicles passing such points as are chosen for observation. Usually these are junctions of important roads, the entrance into cities, towns, etc.

These observations are taken for a period of seven days each month, and during this time a check on the traffic for the entire 24-hour day is also obtained.

On the main highways more detailed observations are made, including such items as the products being handled by trucks, the number of passengers per car, etc.

These observations were started in July, 1923, continuing until September, east of the continental divide, while during the winter of 1923-1924 some observations were made around the larger cities. In 1924 the western slope was included, and the 1923 program repeated in eastern Colorado. During the winter of 1924 and 1925 observations were taken each month at controlling points throughout the state to make possible the development of yearly comparisons, as well as the usual summer observations.

Many interesting variations are noticeable, the following will be of interest to many, I believe:

An average of 45 points of observation during 1923 showed the eight hour daily traffic to be 52.64% of the entire 24-hour daily traffic, while during 1924 an average of 68 points of observation showed the eight hour traffic to be 47.67% of the 24-hour daily traffic.. This shows a general average for the two years to be 50.16%, or in other words 50% of the traffic using the state highway does so during the eight hour business day, or between 8 o'clock a. m. and 4 o'clock p. m.

In the outlying communities, the eight hour daily travel runs as much as 70% of the 24 hours, while around the larger cities where paved roads make evening driving more of a pleasure, we find percentages as low as 38% for the 8 hour period, which indicates heavy night traffic. This may be accounted for by the city life being more or less confining during business hours, and by the arrival of farm produce for the morning market.

The number of horse-drawn vehicles varies from 0.5 to 13.0% of the total travel—the larger percentages showing around the large outlying towns, and in some mining districts where ore and coal are hauled.

Passenger cars are listed as Colorado, or Foreign; light, or heavy. The Colorado cars vary from 30 to 85% of the total traffic, while Foreign cars vary from 1.0 to 75%, depending upon the location of the observation, and the season during which the observation is made. For instance, where tourist routes enter the state the percentage may be found to run as high as 75% of the total traffic, while in the interior, except at tourist centers, or on routes leading into National Forests or play grounds, it varies from 1 to 40%, depending upon such items as scenic and outing possibilities.

During 1923, an analysis developed the fact that light weight cars composed 53.95% of the automobile traffic, and that this class accounts for 48.32% of the total traffic; while light and heavy weight cars together composed 89.57% of the total traffic.

A truck classification during the winter, to analyze the products being hauled during the above years around Denver, brought forth the following information:

That from 40 to 50% of the trucks passing observation points were empty. Merchandise showed a variation from 25 to 45%—farm products from 2 to 10%—machinery from 0.6 to 8.0%, this latter wide variation being due to the oil boom at Ft. Collins.

* Census supervisor, Colorado State Highway Department.

Stream Pollution and Oxygen Balance

How aerobic conditions may be maintained in a stream that receives sewage or other putrefactive matter. Determinations, assumptions, theories and methods of calculation employed by committee of engineers in connection with study of Chicago's withdrawal of water from Lake Michigan.

As a very important part of the exhaustive investigation made by the Engineering Board of Review of the Sanitary District of Chicago on the Lake Lowering Controversy and Program of Remedial Measures, a study was made of the pollution, present and future, of the drainage canal and the Des Plaines-Illinois river into which it flows, and the amount of flow which would be needed to preserve sanitary conditions therein. This study was made by a Committee on Sewage Disposal consisting of Harrison P. Eddy, chairman; Asa E. Phillips, vice-chairman; James H. Fuertes, John H. Gregory, T. Chalkley Hatton, Clarence W. Hubbell and Anson Marston.

This committee utilized information available in more than 230 exhibits, most of them unpublished, and developed a method of calculating the amount of lake water which would be required to thoroughly oxidize the sewage that would reach the drainage canal, making allowance for the reduction in demand which would result from proposed treatment of the sewage* Their conclusions only were given in the body of the report, but a full discussion of the problem and their method of solving it was submitted in an appendix of 250 pages. While this deals with Chicago conditions and requirements, the principles and method of solution are of general application and the discussion is of unusual interest and value to engineers who may have similar problems to solve. An effort is made in this article to present as concisely as possible the principles involved and an outline of the method.

OXYGEN BALANCE

The extent of pollution of a stream may be judged by the oxygen demand, dissolved oxygen and oxygen balance of the water of the stream. The dissolved oxygen is drawn upon to satisfy the oxygen demand. If the dissolved oxygen present exceeds the oxygen demand, it signifies a surplus of dissolved oxygen or positive oxygen balance. If the dissolved oxygen content equals the oxygen demand, the water is stable and the oxygen balance is zero, assuming no available oxygen present as nitrates and nitrites. If the dissolved oxygen is less than the oxygen demand, it signifies that there is a deficit of dissolved oxygen or a negative oxygen balance, and the water is putrescible. However, so long as dissolved oxygen is present, the water is not actually in a putrefactive state. When the dissolved oxygen is exhausted, putrefaction sets in, accompanied by offensive odors.

OXYGEN DEMAND

In studying the effect of sewage and industrial wastes upon diluting water, the composition of such sewage and wastes is of primary importance. Particularly significant are the determinations for biochemical oxygen demand and for suspended solids. The results of the oxygen demand determination are indispensable for computing the drain placed upon the natural oxygen content of the diluting water. At Chicago the oxygen demand results have been used as the basis for estimating the strength of industrial wastes in terms of equivalent-populations. The determinations of suspended solids are of value in estimating quantities of sludge deposits.

THE OXYGEN DEMAND TEST

Two methods have been used to determine the oxygen demand,—the nitrate method and the dilution method. In the former, sodium nitrate is added to the sample in sufficient amount to supply the oxygen demand, and the sample is incubated at a definite temperature, usually 20° C. for a certain period, generally five days or ten days. The oxygen demand is computed as the difference in available oxygen before and after incubation. The latter method is the same, except that the sample is diluted with water in sufficient proportion to supply the oxygen demand. The determination must be made according to a standard method, as variations in temperature and in amounts of residual oxygen beyond certain limits affect the results.

It has been found that in the case of polluted waters, including sewage and effluents from sewage treatment plants, the oxygen demand is 99 per cent satisfied in twenty days at 20° C. This statement assumes that the organic matter in the sample is in a dissolved or colloidal state. If there are sizeable particles of suspended matter, the total oxygen demand of these may not be 99 per cent satisfied in twenty days. The 5-day oxygen demand is 68 per cent of the total and the 10-day oxygen demand 90 per cent of the total. That is, if 68 per cent of the total

*It will be remembered that the War Department granted a permit to the Sanitary District of Chicago to divert 8,500 second-feet from Lake Michigan on condition that it install certain purification works, at an estimated cost of $120,000,000. As a part of this program a North Side activated sludge plant is about half completed and a West Side Imhoff tank plant is soon to be started.

oxygen demand is present as dissolved oxygen, putrefaction will not begin until after the 5th day.

For making calculation based upon estimated future populations it is necessary to know or assume an average biochemical oxygen demand per capita. The 10-day oxygen demand of Chicago sewage has been calculated to be 0.237 pound of oxygen per capita per day by the nitrate method and 0.242 pound by the dilution method. Determinations for eight cities made by the U. S. Public Health Service averaged 0.17 as total oxygen demand. Others have ranged from 0.20 to 0.27. The committee assumed 0.24 for Chicago.

When sewage is treated its oxygen demand is reduced. This reduction in the case of Imhoff tanks has been found to vary from 63 per cent at Atlanta, Ga. to 17 per cent at Rochester, N. Y. (Brighton plant), but in most cases lies between 30 and 50 per cent. The committee assumed 33 1-3 per cent. for Chicago.

Reduction by trickling filters has been found to vary between averages of 90 per cent at the Rochester plant to 63 per cent at Columbus, O., averaging 78 per cent. Assuming 75 per cent, the total reduction by a combined Imhoff-trickling filter plant would be 83 1-3 per cent. During the summer, which is the critical period of polluted streams, bacterial activity in the trickling filters will be at the maximum.

Reduction by activated sludge treatment has been found to vary, in four plants, from 72 to 94 per cent, or practically the same as the combined Imhoff-trickling filter process.

As an illustration of the use of the above figures, the untreated sewage reaching the Calumet Imhoff-trickling filter plant had a total oxygen demand of 115 p.p.m., which was reduced 83 per cent or to 20.0 p.p.m. in the effluent. There were present in the effluent 7.0 p.p.m. of dissolved oxygen and 15.0 p.p.m. of nitrite and nitrate oxygen. The latter probably would not begin to satisfy the oxygen demand until all of the dissolved oxygen had been used.

DISSOLVED OXYGEN

The amount of dissolved oxygen in the water of a stream or lake may vary from 0 to a maximum of 7.63 p.p.m. at 30° Centigrade or 14.62 p.p.m. at 0° Centigrade. It is reduced by the presence in the water of sewage or any substance that absorbs oxygen; and is increased by absorption of oxygen from the air. The amount so absorbed varies with the area exposed to the air, and also with the amount of oxygen already present in the water. When the water is at saturation point, no more oxygen is absorbed.

The oxygen is absorbed at the surface only, and passes to the body of the water by diffusion. The rate of absorption may be increased by turbulence, carrying saturated surface particles below and exposing unsaturated particles to the air.

"The two opposing reactions, de-oxygenation and re-aeration tend always to come to a condition of temporary equilibrium. If the water be nearly oxygen-saturated, and highly polluted. there is a rapid rate of withdrawal of oxygen and a slow rate of replacement, resulting in a decrease in the available dissolved oxygen. As this value decreases, the rate of re-oxygenation is correspondingly increased until it equals the rate of depletion, at which point the two re-actions are for the moment in equilibrium, and there is no change in the actual oxygen content. This equilibrium, however, is only momentary, for the decreasing oxygen demand of the organic matter, resulting from its own oxidation, makes the rate of depletion correspondingly less and permits the gradual recovery of the dissolved oxygen up to its full saturation value. Under conditions of continuous or repeated pollution, however, an equilibrium point may be reached at which the rate of re-oxygenation is exactly equal to that of de-oxygenation, and is so maintained. The importance of the re-oxygenation factor itself and of its accurate experimental determination is therefore obvious. Upon this value, under any given conditions, depends the resultant oxygen condition of the stream for a stated degree of pollution, or, conversely, the maximum amount of pollution compatible with any stated degree of oxygen depletion."

In order to prevent exhaustion of dissolved oxygen in a polluted stream, it is only necessary to have sufficient oxygen present to satisfy the oxygen demand exerted during the time of flow to the critical point or points beyond which the dissolved oxygen increases more rapidly than the rate of depletion of dissolved oxygen.

SLUDGE DEPOSITS

In a stream that has been receiving sewage for some time, sludge generally accumulates along the bottom. This sludge has its own oxygen demand on the water flowing above it; on the other hand, in settling it removes oxygen-absorbing material from that carried in suspension by the stream. The net effect on the oxygen demand is quite complicated.

The biological activities which take place in deposits of sludge are very complex. Various types of organisms exist in these deposits, some of which utilize oxygen in their vital processes and others flourish without oxygen. In the case of the protozoa, the process of respiration is in general similar to that of higher animals. Most of them require oxygen and give off carbon dioxide.

In the deeper parts of the deposits, anaerobic organisms probably predominate, while in the upper layers and on the surface aerobic and facultative organisms presumably are present in the greater numbers. Except when oxidizable gases and gas-lifted solids rise from the deeper sludge, only the surface of the deposits can exert any great avidity for the oxygen in the supernatant waters.

Many of the smaller organisms are used as sources of food supply by higher types of organisms. For example, bacteria are eaten by protozoa which in turn serve as food for still higher

types of organisms. On the other hand, the higher organisms die and their dead bodies are decomposed by lower forms of life. Cycles of life and death and of devouring and being devoured succeed each other or occur simultaneously. Theoretically, various cycles of life and death will follow one another until all organic food material has disappeared in the form of gas or liquid, leaving behind inert mineral matter incapable of supporting further life. Practically, however, the work of the organisms gradually continues until the deposits have been converted into a mixture of mineral and relatively stable organic matter.

In the case of a river section in which there is constant accretion to the existing deposits of sludge, the process of decomposition of the sludge deposits will continue as long as the current supply of sewage solids is maintained. After the supply has been cut off, however, there will be a gradual decrease in the rate of activity and of demand from such sources upon the supply of dissolved oxygen. How rapid this decrease will be, or the length of time required for the action to reach a neglible minimum, is not known.

The process of decomposition of sludge deposits, like all biological action, is markedly affected by changes in temperature, the action proceeding slowly in winter and rapidly in summer. This explains the important fact that sewage solids deposited in the cooler portion of the year undergo relatively little change during this season, but undergo decomposition in summer, when the biological forces attack not only the current supply of sewage solids but also the mass of such solids which has accumulated during the colder season.

The effect of sludge deposits in reducing the dissolved oxygen contained in water passing over them, depends in a measure upon the relative area of the deposits. and to some extent upon their depth. Their effect is also much influenced by the depth and velocity of flow of the stream of water. Sludge deposits may become covered with inert material and thus rendered comparatively ineffective. If the water passing over sludge deposits be so highly polluted that its normal dissolved oxygen has been reduced to zero, it is obvious that the mud deposits can exert no direct demand upon dissolved ozygen.

OXYGEN BALANCE IN A POLLUTED STREAM

There are several direct influences which may cause a difference between the oxygen balance at one station and that at another station farther down stream. There are also several indirect influences which affect the oxygen balance. Among the direct and indirect influences may be mentioned the following:

DIRECT INFLUENCES

Oxygen producing micro-organisms.
Sedimentation or segregation of suspended solids.
Gas lifted and floating sludge.
Re-aeration
Oxygen demand exerted by sludge deposits.

INDIRECT INFLUENCES

Temperature.
Turbulence or agitation at dam overflows.
Time of flow.
Area of water surface.
Oxygen concentration.

If between two stations on the river none of the direct influences has an effect, there will be no change in oxygen balance because whatever reduction there may be in oxygen demand exerted by the organic or polluting matter in the flowing water will be offset by an equivalent decrease in dissolved oxygen, from the supply of which the oxygen will be derived for the satisfaction of the demand.

However, if an additional supply of oxygen is derived from the air by re-aeration and none of the other influences is effective, there will be an improvement in oxygen balance equivalent to the amount of oxygen thus absorbed from the air. On the other hand, if sludge deposits exert an oxygen demand and none of the other influences is effective, there will be a deterioration in the oxygen balance equivalent to the amount of the oxygen used up by the sludge.

The amount of oxygen produced by micro-organisms is difficult to determine but is probably small.

Sedimentation reduces oxygen demand of the flowing water, but what the reduction is in total oxygen demand, if any, has not been ascertained.

Gas-lifted and floating sludge brings into contact with the water matter with high oxygen demand which may temporarily adversely affect the oxygen balance.

Re-aeration of the water has already been discussed.

The rate of re-aeration in one stretch of the Illinois river was found to be about 2.75 pounds per day per 1,000 square feet of water surface. Using this rate as applying to a selected stretch of the river having an area of 422,170,000 sq. ft., it was found that the re-aeration would have amounted to 1,180,000 pounds a day; there was no pollution entering in this stretch; and there was an improvement in oxygen balance from the upper to the lower end equivalent to 275,800 pounds; showing that 904,200 pounds of oxygen per day had apparently been absorbed by the sludge deposits. The water here was low in dissolved oxygen; if more had been present, undoubtedly more would have been used by the sludge. Also there was some sedimentation, which of itself would tend to improve the balance. The committee therefore believed that it was conservative to say that the oxygen demand of this sludge was nearly 1,000,000 pounds per day total, or 2¼ pounds per 1,000 square feet.

In some stretches there was at times a deterioration in oxygen balance.

ESTIMATING DILUTION REQUIRED

The fundamental theories and assumptions on which is based the calculation as to how aerobic condition in a stream may be maintained are summed up by the committee as follows:

1. The oxygen balance at any station is the difference between the dissolved oxygen and the total or 20-day oxygen demand.

2. If there were no re-aeration, no sedimenta-

tion and no sludge exerting an oxygen demand, the oxygen balance at different stations down the river would remain unchanged, under aerobic conditions at least, because the dissolved oxygen used up in satisfying the oxygen demand load would be reduced to the same extent that the oxygen demand was reduced.

3. If there were re-aeration but no sedimentation and no sludge exerting an oxygen demand, the oxygen balance would improve by the amount of dissolved oxygen from re-aeration.

4. If there were re-aeration and sludge exerting an oxygen demand, but no sedimentation, the oxygen balance would tend to improve by the amount of dissolved oxygen from re-aeration and to deteriorate by the amount of oxygen demand exerted by the sludge, the net change in oxygen balance being the resultant of the two opposing influences.

5. With re-aeration and sedimentation taking place and sludge exerting an oxygen demand, the oxygen balance tends to improve by the amount of dissolved oxygen from re-aeration plus the total oxygen demand reduction by sedimentation and to deteriorate by the amount of oxygen demand exerted by the sludge, the change in oxygen balance being the resultant of the three influences.

6. The oxygen demand exerted by sludge in any stretch, neglecting the effect of sedimentation, may be computed by subtracting from the estimated dissolved oxygen from re-aeration for the stretch, the change in oxygen balance; the difference between the change in the oxygen balance which should have been brought about by re-aeration and that which actually did occur is attributable to oxygen demand exerted by sludge, subject to correction for the effect of sedimentation. This is the method which was employed for obtaining the estimates of approximate oxygen demand exerted by sludge deposits.

7. Sedimentation tends to bring about an improvement in oxygen balance; consequently, the oxygen demand exerted by sludge as computed under 6 is too low by the amount of total oxygen demand removed by sedimentation.

8. Some oxygen demand is exerted by the settling solids before deposition because sedimentation takes place gradually as the solids flow along. It may be assumed that the solids that settle in any stretch will exert one-half the oxygen demand which they would have exerted during the time of flow through the stretch had they remained in suspension.

9. The improvement in oxygen balance in the stretch due to sedimentation is consequently the difference between the total or 20-day oxygen demand of the solids which settle in the stretch and one-half of the oxygen demand which would have been exerted by these settling solids in the time of flow through the stretch had they remained in suspension.

10. In determining the oxygen demand exerted by the sludge deposits, uncorrected for sedimentation, the difference between oxygen balance at the beginning and end of each stretch was obtained. These differences included the total effect of the sedimentation which had occurred in each stretch, because the oxygen demand results obtained represent the 20-day or total oxygen demand of the solids present in the samples at the different stations. Therefore the correction for sedimentation applies only to each individual stretch for which the change in oxygen balance was determined, and no correction is required for any stretch on account of sedimentation taking place in the stretch above.

If the estimated oxygen demand due to the sewage from an assumed or estimated future population be taken as a basis, and the dissolved oxygen of the stream be known and its volume of flow, by applying rates of re-aeration corresponding to the dissolved oxygen saturation deficiency, the residual dissolved oxygen at each point below may be computed. Where there is a new inflow of sewage a new calculation is begun. Where a tributary stream enters, its volume times its dissolved oxygen rate will be added, improving the oxygen balance by that total number of pounds.

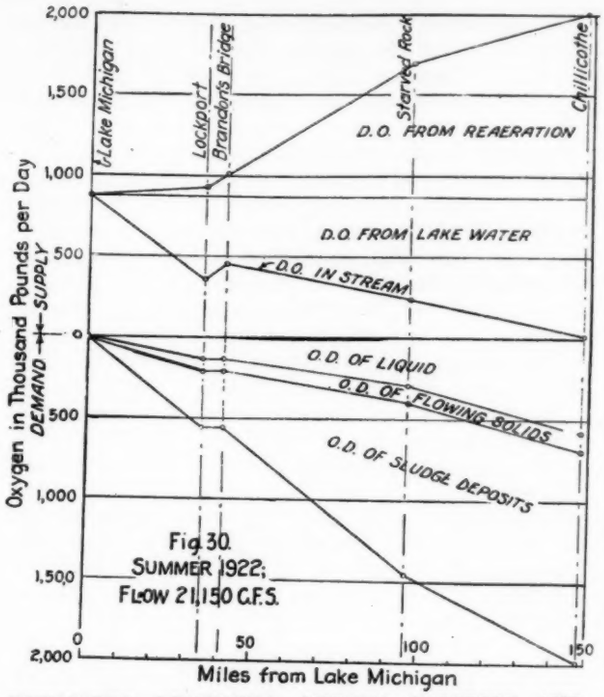
Theoretically, no putrefaction will occur within one day if the dissolved oxygen present exceed 21 per cent of the total oxygen demand of the sewage, nor in two days if the original amount, plus additional oxygen supplied by re-aeration and tributary streams during that time, total 37 per cent. of the total demand, etc. It is conceivable that a stream be always just on the verge of putrefying, fresh supplies of oxygen being added at the same rate as the increase in demand due to age of sewer. If the oxygen balance at the start be zero and there be no sludge nor additions of sewage, there will always be a surplus of dissolved oxygen in the stream, and consequently no putrefaction. (To permit fish life, there must be considerable dissolved oxygen—some say at least 4 or 5 p.p.m.)

If anaerobic conditions exist in the water, the absorption of oxygen may proceed at a very high rate, as much as 52 pounds of oxygen per day per thousand square feet of water surface having been found in the Des Plaines river above Lockport.

It was assumed that, owing to turbulence increasing with velocity, the rate of re-aeration per 1000 square feet would be directly proportional to the velocity.

From investigations of the canal and river, the committee estimated that during July and August, 1922, the oxygen demand of the sludge in pounds per capita per day was 0.077 above Lockport, 0.154 between Brandon's bridge and Ottawa, and 0.051 between LaSalle and Chillicothe, or a total oxygen demand of 0.282 pound per capita per day. This is greater than the total oxygen demand of the sewage, but this was explained as being due to the accumulation of sludge during cold weather and the inactivity of the sludge during that time, while these determinations were made during July and August when the oxygen demand was at its maximum.

The method of estimating residual dissolved



ESTIMATED DISSOLVED OXYGEN SUPPLIES AND OXYGEN DEMANDS IN CANAL SYSTEM AND DES PLAINES—ILLINOIS RIVER IN SUMMER OF 1922 WITH FLOW OF 21,150 CFS OF LAKE WATER AND SEWAGE AT LOCKPORT

oxygen at different points is explained by the committee as follows:

The average known dissolved oxygen content of the lake water in July and August, 1922, was converted into parts per million of the total flow at Lockport, including the assumed quantity of lake water and estimated quantity of sewage. To this was added the total dissolved oxygen from effluents from Imhoff tank-trickling filter and activated sludge plants, converted into parts per million, giving the total initial dissolved oxygen content of the mixture of lake water and sewage or effluents.

From the initial dissolved oxygen content was deducted the total oxygen demand exerted in the canal system to Lockport, derived as previously explained, giving the residual dissolved oxygen at Lockport, neglecting re-aeration. An average dissolved oxygen in the canal system to Lockport was then found by trial which, with the rate of re-aeration applied according to the corresponding dissolved oxygen saturation deficiency, would give a residual dissolved oxygen at Lockport, such that one-half of the sum of the initial and residual dissolved oxygen would give the average dissolved oxygen assumed. A formula was developed for computing this average dissolved oxygen. From the average dissolved oxygen so determined, the dissolved oxygen saturation deficiency was found by subtracting the average dissolved oxygen from the dissolved oxygen saturation value of 8.7 p.p.m. at the average temperature of 23° C.

By applying the rates of re-aeration derived as previously described, converted into parts per million according to the flow at Lockport and corrected according to the average dissolved oxygen saturation deficiency, the dissolved oxygen from re-aeration was determined and added to the residual dissolved oxygen found neglecting re-aeration, thus giving the residual dissolved oxygen at Lockport.

Starting with the residual dissolved oxygen at Lockport, the residual dissolved oxygen at Starved Rock was obtained in the same manner.

Resurfacing in Wabash County

Old gravel and macadam roads scarified, shaped and rolled and surfaced with rock asphalt or emulsified asphalt.

Six years ago, Wabash County, Indiana, adopted the practice of resurfacing its old gravel and macadam roads when they became rough and dusty. The experience of the county was described by J. G. Mylin, highway superintendent of Wabash County, in a paper read before the Perdue road school in January of this year.

Previous to that time, the county had found its gravel and stone roads becoming rough and unpleasant to travel but, figuring the cost of paving them at about $30,000 a mile, decided that this was impossible and that something else must be done. Since 1919, it has developed the following procedure: The old road is first scarified, shaped and rolled. Where necessary, a small amount of limestone is added and rolled until thoroughly bonded with the old surface. Then on this, as a base, the entire roadway is surfaced with Kentucky rock or emulsified asphalt.

The first job of this kind was done in Urbana in 1919. This road was surfaced with Kentucky rock asphalt and is now beginning its 7th year of heavy travel without any further cost for maintenance. In 1922, the tax payers of North Manchester asked for a similar construction on their roads. In 1923, an asphaltic concrete road leading out of North Manchester required resurfacing and on this road emulsified asphalt was used. In the same year, an old stone and gravel road leading out of South Wabash was reshaped and rolled without using any new metal and was then covered with emulsified asphalt. In 1924, the road leading from North Manchester which had been resurfaced in 1922 was extended 1½ miles, Kentucky rock asphalt being used. In the same year two approaches to Wabash were put in shape, using emulsified asphalt. All of these are still in good condition and have cost nothing for maintenance.

Following this experience, in 1925 the county rebuilt six roads as follows: Rich Valley road, 16 feet wide with stone berms; a length of 2,320 feet rebuilt, using Kentucky rock, at a cost of $1.29 per square yard.

Linlawn road, 16 feet wide with stone berms; 3,350 feet rebuilt using Kentucky rock at a cost of $1.34.

Laketon road, 18 feet wide with 2-foot stone berms; 1,600 feet rebuilt using Kentucky rock at a cost of $1.42.

East North Manchester road, 18 feet wide with 2-foot stone berms; 3,320 feet rebuilt using Kentucky rock at a cost of $1.33.

Somerset road, 18 feet and 24 feet wide; 2,400 feet in length rebuilt using emulsified asphalt, at a cost of $1.53.

Chippewa road, 18 feet wide with gravel berms; 3,200 feet rebuilt, using emulsified and Kentucky rock at a cost of $1.53.

Mr. Mylin states that the last mentioned, the Chippewa road, was an old gravel road that had been a constant source of complaint and maintenance cost. In reconstructing it, it was scarified and reshaped by rolling and new limestone added where there was signs of weakness in the base. A course of emulsified asphaltic concrete 1½ inches thick after compression was then laid, and over this a wearing surface of Kentucky rock asphalt ¾ inch thick after being compacted. Mr. Mylin stated that this combination of the two materials was an idea of his own, the object being to use the emulsified asphaltic concrete as a binder course, as it could be laid much thinner than waterbound limestone. The rock asphalt was used as a wearing surface and waterproofing. It is his opinion that the asphalt binder materially increased the strength of the road with very little added cost.

Bond Between Concrete and Steel

Result of investigation on bond resistance as influenced by variations in water ratio, grading of aggregate, quantity of cement, consistency and age.

"Studies of Bond Between Concrete and Steel," by Duff A. Abrams, has just been published as Bulletin 17 of the Structural Materials Research Laboratory, Lewis Institute, Chicago. The report is reprinted from the 1925 Proceedings of the American Society for Testing Materials.

In the introduction to the report Mr. Abrams says:

The working together of concrete and steel in a reinforced concrete member or structure depends on the bond which is developed at the surface of the reinforcement. An investigation carried out by the author at the University of Illinois in 1913 showed the nature of bond resistance and indicated that it was independent of the size of bar or length of embedment, but depended essentially on the quality of the concrete and the condition of the surface of the bar. Those tests indicated a fairly constant relation between bond resistance for plain rolled bars and the compressive strength of concrete; however, at that time the fundamentals of concrete mixtures were not fully appreciated; consequently it seemed desirable to carry out further bond tests in the light of more recent studies of the factors which control concrete strength.

An important recent report from the Bureau of Standards gives the results of bond tests made by the U. S. Shipping Board in 1918 on plain and deformed bars coated with various protective coverings.

The chief purpose of the present investigation was to study bond resistance as influenced by variations in quantity of mixing water (the water-ratio), grading of aggregate, quantity of cement, consistency, age, etc. The tests form a part of the experimental studies of concrete and concrete materials being carried out through the cooperation of Lewis Institute and the Portland Cement Association at the Structural Materials Research Laboratory, Chicago.

His summary and conclusion are as follows:

The bond between concrete and steel is an important element in reinforced concrete construction. This investigation was undertaken for the purpose of determining the relation between bond and the factors which are known to govern the compressive strength of concrete. Bond tests were made by applying a pull on one end of 1-in. plain round steel bars embedded axially in 8 by 8-in. concrete cylinders. The concrete covered a wide range in size and grading of aggregate, quantity of mixing water and cement, and was tested at ages of 7 days to 1 year. Hydrated lime and crude oil were used as admixtures in a few tests. Seven hundred and thirty-five pull-out bond tests and 735 parallel compression tests on 6 by 12-in. cylinders were made.

Following are the principal conclusions:

1. A steel bar embedded in concrete offers considerable resistance to a pull-out load. Slipping of the bar begins at a bond stress of about 10 to 15 per cent of the compressive strength of the concrete, but considerable additional load is taken before the ultimate bond resistance is reached. For pull-out tests of the type used, 0.0005 in. end slip of bar occurred at 55 to 60 per cent of the maximum bond; for mixtures leaner than 1:1, the maximum bond was about 24 per cent of the compressive strength of the concrete and came at an end slip of about 0.01 in., regardless of the characteristics of the concrete.

2. Bond and compressive strength increased with age of the concrete from 7 days to 1 year. For 1:5 concrete of water-ratio 0.88, the bond at 1 year was 134 per cent of the 28-day value and the compressive strength was 148 per cent.

3. Bond responded to changes in water-ratio of the concrete in much the same way as compressive strength; increase in water-ratio due to use of wetter concrete, less cement, or an excess of fine aggregate, resulted in material reductions in both bond and compressive strength. Other tests have shown that the same statement applies to wear and resistance to destructive agencies such as weather, sea and sulfate waters, etc.

4. For mixtures richer than 1:1, the bond fell off, probably due to the greater volume changes during hardening, which is characteristic of such mixtures.

5. The use of 4 per cent of the 28-day compressive strength of concrete as the working stress in bond for plain bars, as specified by the Joint Com-

mittee, is justified; this gives a factor of safety of about 2½ to 3 against first slip.

6. The use of crude oil to replace mixing water, in general, caused a reduction in both bond and compressive strength of concrete. Five per cent of oil reduced bond at 28 days about 20 per cent; at 1 year, about 6 per cent; compressive strength at 28 days and 1 year was reduced about 3 per cent.

7. Replacing cement with hydrated lime decreased the compressive strength and bond about 1.2 per cent for each 1 per cent of hydrated lime in terms of volume of cement or about 2.0 per cent for each 1 per cent by weight.

8. The pull-out test of the form used in this investigation is a satisfactory form of specimen for comparative studies of bond.

Curing Concrete Roads With Silicate of Soda

By R. F. Remler*

During the past five years, contractors in Illinois, Indiana, Iowa, Minnesota, Mississippi, New Jersey, Ohio and Wisconsin have used silicate of soda with success in curing concrete roads, and these results have been substantiated by tests made in co-operation with the New Jersey and Missouri state highway departments and preliminary tests by the United States Bureau of Public Roads.

Success in curing roads with this material depends upon the grade of silicate of soda used, consistency of the solution applied, and time of application. There are a number of grades of this material on the market, each most suitable for a specified purpose, and usually that employed for one cannot be applied successfully to another.

Concerning consistency, in tests by the Illinois State Highway Department, †one-fifth normal solution of silicate of soda was used for curing, while that recommended and used in the tests described below is twelve times as strong. Poor results obtained in these tests can therefore be attributed to a too dilute solution.

METHOD EMPLOYED

The best time to apply silicate of soda is as soon as the concrete surface will support the weight of a man without marking; under normal summer conditions, this is about six hours after being laid. It should not be applied before the initial setting of the concrete. By applying as soon as possible, the maximum amount of water is sealed in the concrete, and the silicate of soda reacts with the free lime on the surface to form a hard and insoluble calcium silicate before the lime combines with the carbon dioxide of the air. If the weather is hot and dry, the concrete should be covered with burlap and sprinkled as soon as laid to prevent the loss of too much water; the burlap being removed a long enough time before applying the silicate to allow the evaporation of surface water. If rain occurs within six hours after application of the silicate, it is best to re-treat the surface with a one to one mixture of water and silicate; but no second treatment is necessary if rain does not fall within such period of time.

The proper mixture of silicate of soda with water should be made (with Grasselli R. B. silicate, three parts diluted with one part of water is the best consistency), and poured or sprinkled on the road and spread evenly over the surface with a brush, squeegee or broom. In general, one pound of silicate of soda is required to cure one square yard of surface at a cost of not more than 2½c, including labor. Drums of the silicate can be distributed along the road, about one drum for each 600 square yards. One man can spread at least a thousand square yards in a day.

TESTS ON CONCRETE BEAMS

Chart No. 1 shows results of modulus of rupture and compression tests made in New Jersey on hay-cured and silicate of soda-cured concrete beams 40"x8"x6", mixed 1:1¾:3½, with a test span of 36 inches. The concrete was machine mixed and shoveled into wooden forms resting on an ash base. The beams were left uncovered for six hours, then one half were covered with hay and the other half treated with silicate of soda; the hay being wet daily for ten days and removed after fourteen days. This test indicated that curing with silicate of soda produces stronger concrete than curing with hay. These

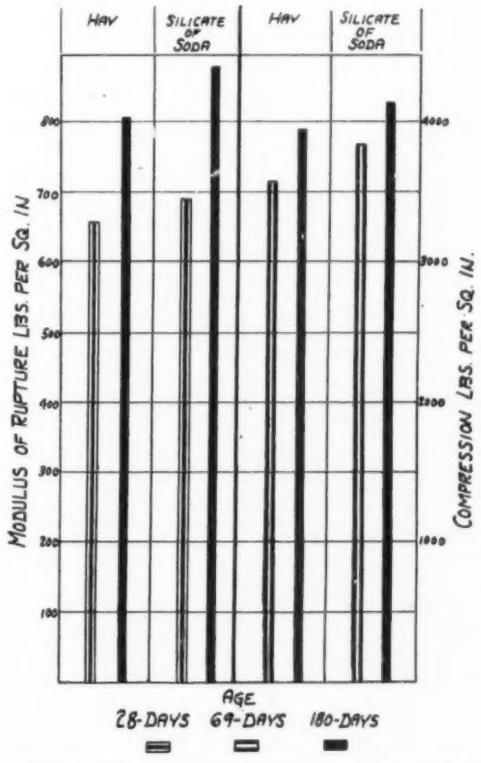


CHART NO. 1—BEAM TESTS CURED, PART WITH HAY AND PART WITH SILICATE OF SODA

*Technical Sales Engineer, Grasselli Chemical Co., Cleveland, Ohio.

†"An Investigation in the Use of Calcium Chloride as a Curing Agent and Accelerator of Concrete," by H. F. Clemmer and Fred Burggraf, *Proceedings* American Society for Testing Materials, 1923.

results are similar to those obtained by tests by the U. S. Bureau of Public Roads.*

Chart No. 2 shows results of tests made on concrete beams in co-operation with the Missouri State Highway Department. These show that either silicate of soda or calcium chloride is ninety percent as efficient as wet earth. The concrete in these beams was mixed as for state road work, being shoveled from the base of the road into forms resting on prepared dirt. The beams were covered with wet burlap and after six hours one-third were uncovered and treated with a solution of three parts silicate of soda to one part water; and on the next day another third were treated with calcium chloride, 2½ pounds per square yard of concrete and the remaining third were covered with earth which was kept wet for ten days and removed after fourteen days.

The Missouri State Highway Department made a practical test on a section of road, and after it had been down ten days reported†: "In general it might be said that this material does not form a glazed seal over the surface, but that it seems to penetrate the surface pores, sealing the pavement in that way. We made an investigation recently to determine how the first of the material used was curing the pavement and found that the concrete below the first half inch was green and in apparently good condition."

EFFECT ON CONCRETE

When applied to green concrete, silicate of soda prevents rapid evaporation by filling pores and sealing the surface. Surfaces treated with this material

*Private communication from office of U. S. Bureau of Public Roads.

†Construction Reporter, Volume 11, No. 2, 1925.

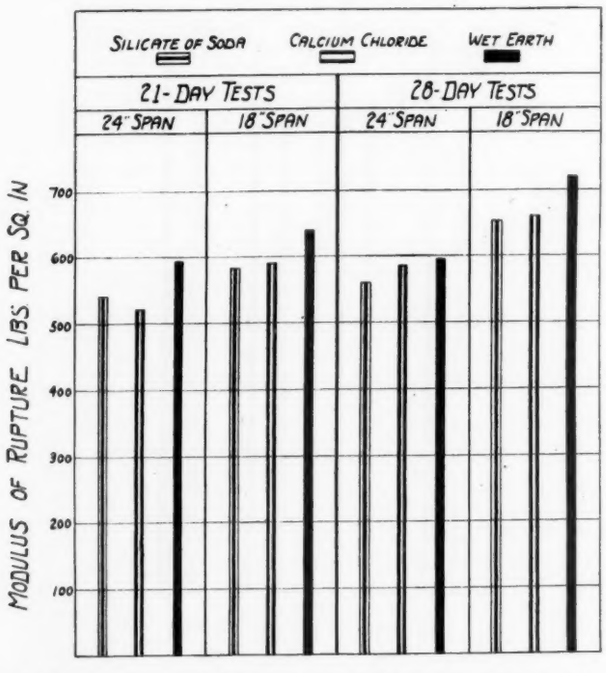
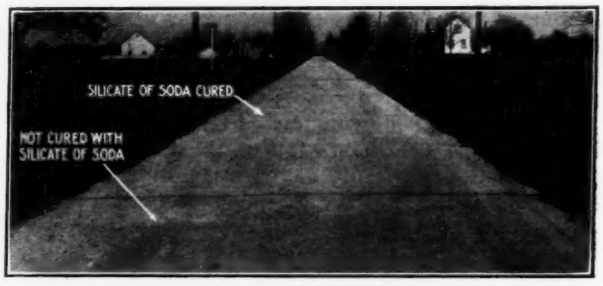


CHART NO. 2—MODULUS OF RUPTURE TESTS ON CONCRETE BEAMS CURED WITH SILICATE OF SODA, CALCIUM CHLORIDE, AND WET EARTH



BASSETT ROAD, CUYAHOGA COUNTY. BUILT IN 1923

were reported by the U. S. Bureau of Standards* to be hard and uniform; and the Portland Cement Association recommends several applications of a dilute solution of silicate of soda for improving the wearing qualities of concrete floors.

As concrete does not reach maximum strength until it is six to twelve months old, while it begins to carry traffic after its second to fourth week, it is subjected to the deteriorating effect of traffic long before reaching its maximum strength; but silicate of soda curing gives a hard surface by the time the road is opened.

It is indicated that this material increases the strength of concrete, chart No. 3 showing the results of compression tests made at Mellon Institute, Pittsburgh, Pa., on three sets of cylinders, one set cured in water and the other two in different solutions of

*"Report on Service Tests on Concrete Floor Treatment." October 28th, 1920. "Soaking Concrete in Magnesium Fluosilicate and Sodium Silicate Solutions," results of tests of U. S. Bureau of Standards, "Concrete," Vol. 17, 1920.

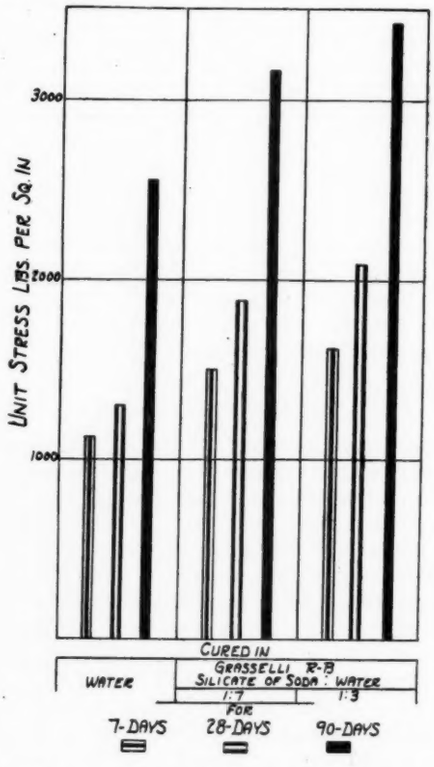


CHART NO. 3—COMPRESSION TESTS ON CONCRETE CYLINDERS CURED, SOME IN WATER, THE REST IN SILICATE OF SODA AND WATER MIXED, PART 1:7 AND PART 1:3

silicate of soda. It appears from this that an excess of silicate of soda has no harmful effect. When used for curing or as a post-hardening treatment, it prevents scaling by combining with and acting as an additional cement to the laitance which rises to the surface of the concrete during the finishing process. Sand pockets or porous spots often occur in concrete surfaces and develop holes under traffic. It has been found that the addition of sufficient silicate of soda to fill these pockets will strengthen the concrete here and prevent pock marking. Silicate of soda has no corrosive effect on steel reinforcement; in fact, it is used to prevent corrosion in hot water systems.

Use of Trenching Machinery by Water Departments

Use by the Water Department of Los Angeles of excavating machinery, backfillers, pneumatic machinery, truck crane and trench pumps. New Bedford, Mass., Water Works used trenching dipper steam shovel for laying five miles of large pipe.

Mechanical Trenching Equipment at Los Angeles*

By THOMAS BROOKS†

Previous to the world war the Bureau of Water Works and Supply of the city of Los Angeles had given very little thought to the use of mechanical equipment for the excavation of trenches, the laying of pipe and the backfilling of trenches. Up to that time there was a plentiful supply of efficient labor at wages which were reasonable from the employer's standpoint. The war however was the cause of a great change in this respect. During that interval and almost up to the present time efficient labor for trenching and pipe laying was not available, which will explain in part why the Bureau of Water Works and Supply of this city is so well equipped with mechanical apparatus for handling this class of work. Economy is another important factor worthy of consideration, as a result of the change from the old to the more modern methods.

Due to the phenomenal growth of the city of Los Angeles during the last three years, extension of our mains, to supply new subdivisions being put on the market, required the installation of from 75,000 to 140,000 feet of pipe per month, and in addition to the large volume of trunk-lines and betterments it became absolutely necessary, in order to meet the growing demand for water, to speed up our work in every way possible. By introducing modern mechanical equipment we were able to meet this condition satisfactorily to all concerned.

At present we have a fleet of seven pipe-trenching machines, two in the San Fernando valley and five for the city proper. Of these, four are the "P & H" and two the "Buckeye" wheel type excavators for excavating trenches from 18 to 21 inches in width and approximately 7 feet in depth; one ladder type "Buckeye" machine for excavating trenches from 24 to 42 inches in width and 8 feet in depth.

In new tracts where there are no obstructions the small machines will dig a trench from 2,500 to 3,600 lineal feet in eight hours at a cost for operation, helper and fuel of approximately $18, the average depth of trench being 3½ feet. The large excavators are capable of digging a trench 42 inches in width and 5½ feet in depth and a length of from 500 to 1,500 feet in eight hours at a cost, not including upkeep, depreciation or overhead, of about $25.

On account of the time consumed in moving the machines from job to job and the delay occasioned by break downs, the average footage of trench excavated per machine for a period of several months would be very much less than the figures above quoted. As to depreciation, the oldest piece of equipment of our present fleet has been in active service for five years and I feel sure it is good for at least two years more. Four of the wheel type machines over a period of eight months dug a combined total footage of 549,446 feet of trench varying from 18 inches × 3 feet, to 21 inches × 4 feet, at a cost per lineal foot (including gasoline, cylinder oil, repair material, repair labor, operator, moving expenses, and overhead) of five cents. Our ladder type machine dug 100,000 lineal feet of trench ranging from 31 inches × 4½ feet to 42 inch × 5½ feet at a total cost (depreciation not considered) of six cents per foot. The Department has a 20-ton low trailer for moving the wheel type excavators from job to job, drawn by a 5-ton capacity truck at the rate of from three to eight miles per hour.

Backfilling of trenches is done by two Holt push-blade backfillers, and two P & H trench backfillers. The Holt machines will backfill an 18 inch × 3 feet trench at the rate of from six to eight thousand lineal feet per eight-hour day. This is considered a very economical and reliable machine. For backfilling trenches, 24 inches and up, we use the P & H backfillers with or without the boom. With the boom attachment one

*Paper before California Section, American Water Works Association.

†Superintendent of Domestic Distribution, Bureau of Water Works and Supply, Los Angeles, Calif.

operator can backfill from five hundred to seven hundred feet of 36-inch trench per eight-hour day. These machines are moved from job to job on one of our large trucks or on a 20-ton capacity trailer. For digging bell holes in hardpan or sandstone we have a number of pneumatic spades which are also very useful for tunneling below railway and other structures. One spade will accomplish the work of about four men with picks.

For cutting concrete pavement the Department has several pneumatic concrete breakers. This method of breaking concrete is such an improvement over the old method of gad and sledge that there is no comparison between them.

Compressed air for caulking lead joints, field riveting of sheet-steel mains, driving the pneumatic spades, concrete breakers, cutting cement joints from cast iron pipe and for a multitude of other purposes is furnished by three Ingersoll-Rand compressors, each having a capacity of 212 cubic feet of air per minute and mounted on 2½-ton capacity trucks.

For lowering and placing in the trench, cast-iron pipe of the larger diameters (i.e., 20, 24, 30 inches and up) and for handling large valves and fittings, we are using an "O & S" truck-crane mounted on a 5-ton capacity truck; and after using this crane continuously for several months, handling 24 inch Class "C" cast iron pipe, I have found it to be satisfactory in every respect and I can highly recommend a crane of this type. We also have a smaller truck-crane for handling loads of one ton and less. For unloading pipe from cars and loading trucks at our pipe yards, the Department has one P & H and one Brownhoist crawler tread type, 40-foot, boom crane. It would be almost impossible for the Department to handle the large tonnage of cast iron pipe received without the aid of these cranes. They have proved to be all that is claimed for them by the respective manufacturers.

For trench pumps we have one 900-gallon per minute centrifugal pump mounted on a four-ton truck together with a generator for furnishing current to a large number of electric lights for night work. In addition to the pump and generator, this truck also carries a 178-cubic-foot per minute air compressor. All of the above equipment is operated by the truck motor.

For handling smaller quantities of water, four power-driven diaphragm pumps are used, mounted on small rubber-tired trailers, which are good for 12,000 gallons per hour each. We also have an electric-driven emergency trench pump and lighting plant mounted on a special 2½-ton capacity truck. This 800-gallon per minute pump is unique, in that it requires no suction hose, pipe or priming, it only being necessary to connect up the discharge hose, push the button and the pump does the rest, and at the same time generates enough current for a large number of ninety candle power lamps. This piece of equipment was designed and assembled in the Department machine shop.

In conclusion, I would state that all repair work and overhauling is done in the Department machine shop and there is not one unit of this trenching and pipe laying equipment that is not doing its "bit" toward furnishing the people in the city of Los Angeles, the most necessary of all commodities, domestic water.

Use of Machinery in Pipe-Laying*

By Stephen H. Taylor†

The replacing of hand labor by machinery on the larger jobs is interesting as showing how much can be done by that method with a few men.

In 1920 the New Bedford Water Works contemplated laying 6,600 ft. of 36-in. cast-iron pipe, in addition to the ordinary annual extensions which are necessary to keep pace with new building operations constantly creeping out beyond the limits of existing mains.

Labor at that time was very scarce; to say nothing of the excessively high wages demanded.

It was decided to purchase a 14B Bucyrus steam shovel with an extended dipper arm and a special trenching dipper of half-yard capacity, which permits the digging of a trench with perpendicular sides and sufficient depth. We afterward used a ⅝-yd. dipper on the same machine with good results for the wider trenches.

The shovel travels over the trench on platforms made of 10-in. x 10-in. or 12-in. x 12-in. green oak timbers made up in sections. These sections are long enough to give a good bearing on the sides of the trench, about 6 or 7 ft. wide. Three or four sections are used and the shovel quickly picks up the section behind and places it ahead as the work progresses.

In 1921 work was started on a line of 48-in. cast-iron pipe about 19,000 ft. long. This work was located eight to eleven miles from the center of the city and the laborers had to be either boarded near the job or transported to and from the city each day.

In order to facilitate handling the pipe, which weighed four to four and one-half tons each, a 14B Bucyrus "Clamshell" and derrick, mounted on caterpillar traction, was purchased. With this outfit and gasoline-driven air compressors for handling ledge and large boulders, and gasoline-driven pumps for handling water in wet trenches, the work was accomplished by a crew of from fifteen to twenty men and two or three trucks with dump bodies.

The shovel travelled over the trench on platforms, as previously described, depositing the excavated material into trucks which dumped it into the backfill close by. The derrick closely followed the shovel, thus keeping the haul by the truck to a minimum.

With the outfit described above and reasonably good earth conditions, from 120 to 180 ft. of trenching, pipe-laying, and backfilling per day were accomplished. The crew was so small that transportation to and from the job daily was an easy matter.

Some sections of the work were in sand, too soft to carry the steam shovel over the trench. Under that condition the excavating was done by a clamshell bucket on the derrick, laying alongside the trench. The banks were so slippery that it some-

* Paper before New England Water Works Association.
† Superintendent of Water Works, New Bedford, Mass.

times required quick work to get a pipe in the trench before the bank slid in.

The work, with the exception of a little filling-in of a slow section, which was completed early in the third season, was completed in two seasons; laying off during the winter months.

All sorts of earth conditions were encountered: hard pan, with large boulders; quicksand; dry, sliding sand; and even swamp where pile-driving was necessary. The same derrick with the 30-ft. boom made an excellent pile-driver.

I can heartily recommend the above-described outfit to anyone having a big job of pipe-laying to do.

The cost of the two jobs described was as follows:

COST OF 48-INCH MAIN LAID IN 1921-1922-1923.
Class "B," "C," "D," N.E.W.W.A.

Pipe $46.50 per ton, 18,813 ft.
Specials $130 per ton.

	Total.	Per ft.
Pipe and specials	$326,096.04	$17.33
Gates, hydrants and checks	13,055.06	.69
Leadite and gaskets	6,364.32	.34
*Tools	*29,173.31	*1.56
Labor (see subdivision)	93,705.33	4.98
Lumber	4,331.11	.24
Fuel, oil, grease, etc	7,205.01	.38
Consulting engineering	1,179.76	.06
Replacing road surface	8,929.56	.47
Miscellaneous expense: Travelling, telephone, telegraph, printing, accident, etc	5,535.30	.29
	$495,574.80	$26.34

* Includes new tools purchased which are still in good condition, to the value of $18,940.05, or about $1.00 per foot.

Labor may be divided as follows:

	Total.	Per ft.
Excavating, laying, backfilling, grading, and watchman	$84,598.48	$4.50
Unloading and distributing pipe	6,906.52	.37
Tools	1,574.48	.08
Preliminary work	625.85	.03
	$93,705.33	$4.98

COST OF 36-INCH MAIN.
6,846 ft., Class "D," N.E.W.W.A.

Laid in 1920-1921.
Pipe $64.00 per ton.
Specials $145.00 per ton.

	Total.	Per. ft.
Pipe and specials	$121,191.85	$17.70
Hydrants and gates	6,052.25	.88
Leadite and gaskets	1,441.85	.21
Labor	33,139.98	4.84
Fuel, oil, grease	330.34	.05
Lumber	502.90	.07
Miscellaneous	371.59	.06
	$163,030.76	$23.81

We have used the shovel for some of the smaller jobs in the city; but for short lines scattered in various sections of the city it does not pay, as the cost of moving long distances is excessive.

Another interesting feature of the laying of the 48-in. cast-iron pipe was laying a curve of approximately 14°, or 1,740 ft. radius, with straight pipe. It was pronounced by all who saw it as a pretty piece of pipe-laying, and was perfectly tight when the water was turned on. This curve was in swampy country and mostly laid above the surface of the swamp. It was well braced to prevent the joints from blowing out.

Practically all the joints on both the 36-in. and 48-in. lines were made with leadite and braided jute packing, which resulted in a great saving of labor, especially in wet trenches where the digging and maintaining of larger bell holes would have entailed much more labor and expense.

As an illustration of the difference in cost of joints made with lead and leadite: two lead joints were made at a cost for packing, lead, and labor of $18.06 each, whereas the same items for leadite joints cost about $4.42 each. It took three men one hour and forty minutes to make a lead joint, whereas the same three men averaged from six to eight joints per hour with leadite. This does not take into account the extra cost for bell holes when lead joints are made.

Maintaining Washington's Gravel Roads

Maintenance of gravel highways in western Washington is found to be more difficult than in some other states because of the absence of rain during the dry season. During the past few years, what is known as "dry dragging" has been practiced to an increasing extent. The present practice, where the traffic runs between 500 and 1,200 cars a day, is to maintain windrows of fine material, generally grading from ¾ inch to dust, at the edges of the road and every two or three days drag this material from one side of the road across the surface and leave what remains as a windrow on the other side. This practice is found to keep the surface fairly smooth, but the amount of dust created is not only disagreeable but so obstructs the view of drivers as to be dangerous. Moreover, the suction of the cars removes the material rapidly and much of it disappears and must be renewed at a considerable addition to the maintenance cost.

Richard Wilson, district highway engineer, states that several methods were tried for keeping down the dust under a traffic of over 1,200 cars a day, but none was found which would not cost more than the state or county could afford. Sprinkling was tried in two different districts of the state and showed a cost on the average of approximately $10 per mile per day, and was required for 3½ months of the year; and even then, the dust was only partially kept down. Oiling was found to be expensive and was objected to by the traveling public.

Two years ago on a half-mile stretch of highway above North Bend, "Dowflake" was tried with apparently satisfactory results. During 1925, 2.4 miles of roadway on the Pacific highway south of Bellingham carrying an average traffic during the summer of 2,200 to 2,500 cars a day, "was treated with rather satisfactory results," said he, "but on account of the expense, such an application cannot be generally used. After sprinkling on the road this substance absorbs moisture from the air sufficient to dampen the loose mulch on top of the surface. During the warmer portions of the day, the road seems to dry out but the dust that appears seems to rise only about 3 feet off of the ground and then rapidly settles down." Additional moisture is absorbed each night. Dragging is continued as before the

application of the calcium chloride, but this "does not seem in the least to impair the action of the treatment."

In applying this chloride 1¼ lbs. per square yard of road surface were used in the first application, ¾ lb. in the second application, and if a third application is necessary, ½ pound. The first application was placed about the middle of June, and the second about a month later. "These were placed over a width of about 18 ft., as it was anticipated that enough material would spread over the edges during the blading operations to keep down the outside dust. The third application was omitted owing to the lateness of the season and the expected early approach of rain."

"The results obtained were satisfactory, as the dust was positively eliminated except for a small amount which appeared during the heavy traffic about a month after the second application. This could have been entirely prevented by making the third application of ½ lb. per square yard, but at no time was the dust sufficient to justify this additional expense."

There was no saving in amount of blading required, but it does appear that less of the surfacing material was blown away so that there would be a saving in the replacing of this. The cost of the chloride in place was approximately $500 per mile of roadway, or 4.7c per square yard of road surface.

"The only objectionable feature so far noted is the action of the chemical during the early winter months, as the treated section appears to have more free water on the surface after each rain, with a slight consequent additional softening of the road surface."

The "Liberal Professions"

At a banquet in honor of Charles A. Magrath at Toronto, November 18th, Arthur Surveyer, consulting engineer of Montreal, concluded a brief address with the following toast:

"To the members of the liberal professions, society owes all the important things in life:

"To the lawyers, we owe the laws which govern us and the enforcement of these laws;

"To the doctors, the conservation and lengthening of our life;

"To the religious minister, our spiritual comfort;

"To the architects, our monuments and our homes, and, speaking in all humility, to the engineers, society owes nearly all the rest.

"Gentlemen, I give you—

the lawyers, the dominant figure in our public life;

the doctor, the guardian of our health;

the religious minister, the healer of our spiritual wounds;

the architect and the engineer, the materializers of our dreams."

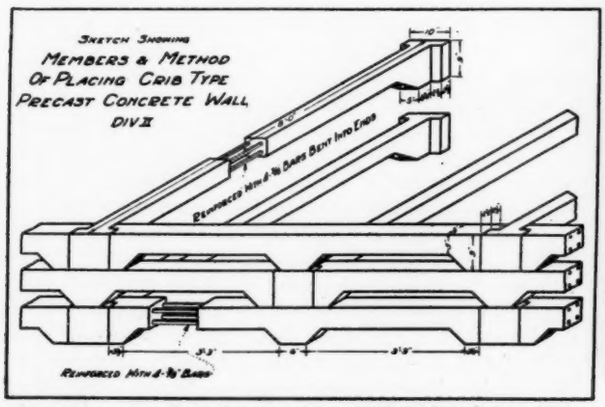
Concrete Crib Retaining Wall

Division II of the California state highways recently completed a section of retaining wall on the Pacific highway in the vicinity of Weed, Siskiyou County, that has a number of interesting features. It is described as follows in "California Highways," "The wall is made in the form of a crib composed of precast reinforced concrete members which interlock one with the other, to form a stable structure. The alternating layers of headers and stretchers are each made up of members 5 inches square and 8 feet long, with necessary lugs for interlock cast at either end.

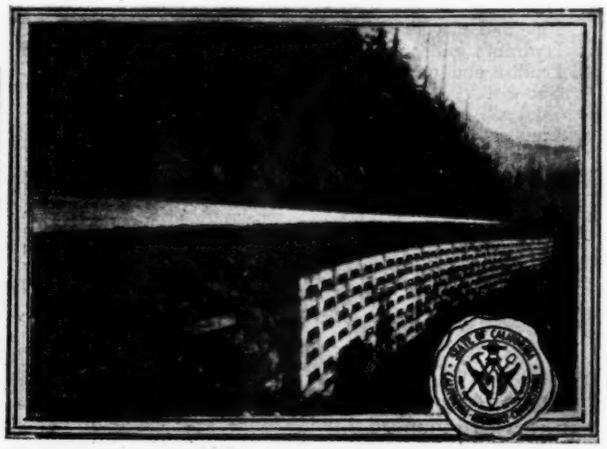
"This particular wall is 165 feet long, varying in height from 4½ to 7 feet. It serves to retain the roadway slopes at a point where the location is on a hillside, immediately above the Southern Pacific Railroad. The crib type was chosen because of the difficulty encountered in securing a safe foundation for the usual type of masonry or concrete wall, and because of the necessity for ample drainage at this point.

"Due to its lighter weight and flexibility, this type of wall has many advantages and can be placed on foundation material that would not support a gravity wall. Water from behind it drains out freely, eliminating another danger.

"Eighteen cubic yards of concrete were used in casting the members of the wall in question. The total cost of the structure, in place, including backfill, was $1,179.45, as compared with an estimated cost of $1,700 for a rubble masonry retaining wall. All of the work can be done by common labor, while walls of other types often require high-priced skilled labor.



METHOD OF CONSTRUCTING CONCRETE CRIB RETAINING WALL



CRIB TYPE WALL ON PACIFIC HIGHWAY, CALIF.
Built of precast concrete members

Recent Developments in Bituminous Paving Practice

Leaner mixtures and wider gradation limits of sand; more care in construction; sand-asphalt pavements; veneer macadam types; bituminous earth road.

A paper with the above title was presented by Harry M. Rex before the American Road Builders' convention, in which he summed up these developments under the two headings of (1) improvements in asphaltic mixtures and construction methods, and (2) wider adaptation of bituminous construction to local materials and conditions.

MIXTURES AND METHODS

Other than the extremely efficient standardization of production by commercial manufacturers and the recent reduction of the too numerous grades of asphalt to a more practical few, no great change has occurred in the various asphalt binders. There have been changes, however, in bituminous mixtures. From time to time various ideas have been advanced dealing principally with research into sand structures, and the introduction of admixtures. Two especially noteworthy theories have been advanced lately and are being investigated. The first deals with the proposition that higher percentages of added filler insure higher stability results, and that extreme fineness of this material is greatly to be desired. The superiority of hydrated lime over the usual commercial limestone dust as a filler has been indicated by laboratory tests.

The second theory maintains that much wider gradation limits of sands than those which now prevail may be permissible. Among the interesting experiments along these lines are those of Prevost Hubbard, although no definite conclusions have yet been reached. It is a matter of fact, however, that sands which in many respects lie far outside of the limits commonly accepted as standard gradation, have been used with gratifying results in the construction of sand asphalt in North Carolina.

Concerning asphaltic mixtures, it is perhaps sufficient to mention the growing tendency toward leaner mixtures to meet modern traffic requirements. This applies not only to the final graded surface mixtures, but also to the large aggregate black base, sheet asphalt binders, and sand asphalt bases. The slight decrease in bitumen content of the sand asphalt bases, while sacrificing little of the flexibility, appreciably increases the stability.

In the matter of construction, much more care is being taken with details and it is being realized more than ever before that the riding quality and durability of the wearing surface are dependent, either directly or indirectly, on every detail of the structure from the subgrade to the wearing surface. It has been learned, for example, that if the base is rough and wavy, these irregularities will show up in the surface of the asphalt regardless of how great pains are taken with surfacing it. It is generally found that, while a truer surface may be obtained during construction where a fine aggregate mixture is laid in one course, these mixtures are more sensitive to base irregularities than those in which the larger particles predominate.

Advance has also been made from the contractor's viewpoint, improvements in methods having been made over the old costly and inefficient ones. Last year two contracts for sand asphalt were awarded in North Carolina which were practically the same in all respects. One contractor used a plant mixing a box of 2,000 pounds and the other a 1,000 pound box. The former finished eight miles in 54 days, and the latter, 10 miles in 126 days.

WIDER ADAPTATION

Discussing the second point, the wider adaptation of bituminous construction to local materials and conditions, Mr. Rex referred to the development of sand-asphalt pavement in North Carolina which has been described in PUBLIC WORKS. Use of this pavement has disclosed what might develop into a structural defect,—a potential plane of cleavage due to the fact that the pavement was being laid in two courses of very different mixtures. Experiments are being carried on in constructing one-course sand-asphalt pavements laid to compacted thickness of 3½, 4 and 4½ inches; while other experiments are being tried with the use of a paint coat of hot asphaltic cement thinly and uniformly squeegeed on the sand-asphalt base course prior to placing the wearing surface. The latter has the advantage over the one-course sand-asphalt that it is possible with its use to obtain a better surface.

Another type which has been equally successful in several states consists of surfacing either new or old waterbound macadam with an asphaltic hot mixture. The depth of stone in the macadam should be not less than six inches after compaction, which will probably require scarifying the old stone and adding new. This is then rolled, sprinkled, etc., as in ordinary waterbound macadam. Just prior to laying the bituminous mixture the surface is swept clean to expose at least ¼ inch in depth of the top stones. On this base is spread a layer of modified Topeka mixture closely resembling sheet asphalt in the gradation of the finer particles and in the proportion of a bitumen content to finer aggregate, and containing from 26 to 29 percent of stone passing a ⅝ inch screen and retained on a 10 mesh sieve. The thickness is made sufficient to give a compacted thickness of two inches. To confine the mixture during compression, temporary wood headers are spiked along the sides.

In reconstructing old penetration macadam roads in North Carolina, it is almost always necessary to widen them, and this is done either with Portland cement concrete or equally as well with bituminous black base. Where grade or profile have to be changed slightly in preparing the macadam for the surface, it is better to raise depressions than to trim down high places, and rather open binder is used for this

purpose. Mr. Rex stated emphatically that it was necessary to hold this binder course as lean and dry as is workably practicable. This binder course ought not to exceed four inches in compacted thickness. On the base so prepared is placed a two inch wearing surface of either modified Topeka mixture or sheet asphalt. This method enables transforming the worn out road into a very serviceable one at a cost which is much less than that of new construction.

Need has developed of more satisfactory inferior classes of construction and several have been experimented with, but to date only two have been developed to the point of moderate success. The simpler of these consists of scarifying an existing sand-clay or top-soil road to a depth of two or three inches and broadcasting over this, in a uniform thin layer, stone uniformly graded from one inch to two and one-half inches in size. The stone is thoroughly mixed with the soil by means of harrowing, puddling and machining, by which the stone is thoroughly imbedded in the soil, yet presents a uniform rough surface which will effectively anchor a hot mix surface. Several types of surfacings have been used on such bases.

A more elaborate and expensive modification of the veneer idea is found in shallow macadam surfacings which differ from the Upham veneer above described, in that no attempt is made to key the surface to the soil subgrade. The surface consists of three inches of compacted penetration macadam constructed in the usual manner except for the seal coat. After the intermediate size stone have been rolled into the stone below, a surface is placed thereon of sheet asphalt mixture compacted to an average thickness of one inch. This not only provides an effective seal, but also a very pleasing wearing course.

Excellent drainage is a prerequisite to the use of either of these veneer macadam types.

The author also described a method being tried out by building up a pliable and extremely elastic mat by successive applications of asphaltic oil. After obtaining a soil or gravel road which is thoroughly compacted and of good uniform surface, a specially prepared tar is applied at the rate of .3 or .4 gallon to the yard and covered with 12 to 15 pounds of sand which is uniformly distributed by dragging with sectional broom drags after about six hours. After five or ten days the loose sand is swept to the sides and asphalt is applied at the rate of .4 to .5 of a gallon and covered with about thirty pounds of sand per square yard, which is broom dragged as before. The asphalt application is repeated from year to year until, at the end of the sixth year, a mat two or three inches thick has been built up. This is known as a bituminous earth road.

Taxing Parking Privileges

At the first meeting this year of the Board of Street Commissioners of Boston, a letter was received from Mayor Malcolm E. Nichols requesting it to amend the traffic regulations of the city, so as to provide for charging a fee for the privilege of parking automobiles throughout the city. This was done at the request of the Administration Committee on Ways and Means, the chairman of which is Prof. W. B. Munro. The committee was assured that such a fee would be within the jurisdiction of the street commissioners.

The plan is to restrict the privilege of parking in the streets of Boston to automobiles which carry a small metal tag or plate (somewhat similar to the wheel-tax plate used in Chicago) indicating that a license fee has been paid to the city for this privelege. It was suggested that the fee be not less than $5 or more than $10 per annum. The committee believed that this would bring a net revenue to the city of at least $500,000 per annum with a $5 fee. It was thought that a special definition of the term "parking" would be necessary with reference to the license regulations, such as would prevent its application to delivery cars and other vehicles which only stop to perform specific errands. It was also recommended that it be provided that a parking licence may be suspended or revoked for repeated violations of the parking rules.

There was no idea of modifying in any way the existing traffic regulations as regards time limits, restricted streets, or any other limitation now maintained on parking privileges. All such regulations would continue as they are, the suggested amendment merely depriving those who had not taken out a parking license, of the privilege of parking at all in any public street. Such owners would necessarily have to make use of private grounds or buildings for parking.

From data collected by this committee, the Chamber of Commerce, and the street commissioners, it was estimated that at least 100,000 cars avail themselves of parking privileges in Boston's streets and parkways during the course of a year. A count of 200 cars parked all day on certain streets of the business district recently showed 85 percent of them owned by non-residents.

Recent Developments in Concrete Paving Practice

Thickened edge cross-section and longitudinal dividing plane; smoother surfaces; use of profilometer, subgrade template, calcium chloride and aluminate cement.

This subject was discussed by H. E. Surman, engineer of design, Division of Highways of Illinois, in a paper before the American Road Builders' convention. He named as one of the most far reaching developments in concrete paving design, the thickened edge cross section developed by the Bates road tests; this design including also a longitudinal dividing plane in the center of the pavement with transverse dowel bars. He stated that more than 30 of the states are now using this design or some modification

of it. A recent development is the increasing of the central thickness from 6 inches to 7 inches, with corresponding increase in the edge; this not for the purpose of permitting heavier loads on the highway, but as a safeguard against fatigue due to a greater frequency of maximum loads.

Much progress has been made in meeting the public demand for smoothness in the pavement surface. "In Illinois very good results have been obtained by the use of the compacting or finishing machine, belts, 10 ft. straight-edge and long-handled float. The use of the long-handed float and 10-ft. straight-edge to remove the surplus water and laitance from the surface of the pavement have been largely instrumental in eliminating the scaling action that was so common in concrete road construction up to a year ago." The 10-ft. straight edge is used for checking up smoothness both before and after the concrete takes its initial set, and all variations exceeding ¼ inch are at once eliminated.

The Illinois highway department has recently been trying out a machine known as the "profilometer" for testing smoothness after the concrete has attained its initial set. This consists of a number of rubber tired bicycle wheels with a device for recording the contour of the pavement as the machine moves over the surface. The department tried out profilometers having 8 wheels, 16 and 32, and found that the 8-wheel machine recorded 97 percent as many high or low spots as were recorded by the 32-wheel machine, and therefore appeared to be sufficiently accurate for practical purposes as well as being easier to handle. Besides being a good detector of rough spots in the pavement, this machine furnishes an accurate graph of the surface of the pavement that could be used in future investigational work.

It is very important that the full thickness of concrete called for be obtained, and in order to insure this, it is the practice in Illinois to require the use of a heavy subgrade templet which is mounted on rollers which travel on the side forms between the mixer and the concrete. This checks the sub-grade after the mixer has passed over it and immediately before the concrete is placed. In addition to this, the resident engineer is required to take not less than three cross sectional readings on the subgrade each day, and again on the finished pavement just after it has taken the final set. A final check consists of drilling cores and determining the actual thickness.

It is considered important to make sure that the quantity and quality of the concrete are as specified, and to this end daily checks are made of the amount of cement used and the number of batches of concrete required for the area of pavement laid that day; other precautions being automatic methods of measurement to secure uniformity of batches, automatic locking and timing devices to secure uniform mix, and automatic water control to secure uniform consistency. There is also a tendency toward standardization of concrete mixers.

Probably Illinois has used more calcium chloride as a curing agent than any other state, not less than 2,000 miles of concrete pavement having been cured by this method. "The calcium chloride is applied in either flaked or granulated form and spread uniformity over the surface by squeegees or suitable mechanical device, at the rate of about 2½ pounds per square yard of pavement. The main advantages over other curing agents are the saving of labor and the fact that concrete so cured attains a greater strength in its early stages."

"The use of aluminate cement for paving short gaps and particularly for patches in maintenance work is becoming more popular. This enables the pavement to be opened within 24 hours after the concrete is placed, and while the cost in small quantities is about four times that of Portland cement, it is justified from the standpoint of better service given to the traveling public and the avoidance of lengthy detours."

The use of the traffic line is one of the recent developments which is now used in most of the states, and in the author's opinion has done more to prevent accidents on highways than any other one factor.

A Writer's Description of a Steam Shovel

The following description of a steam shovel in operation, by Al. G. Waddell in the San Francisco Chronicle, is quoted by "California Highways," which states that it was written after a visit to highway work going on in Merced Canyon, and that "engineers will admire his ability as a writer fully as much as he evidently admires the modern road building machinery operated by the California Highway Commission."

"Sinking its fangs deep and clamping its great jaws, the huge monster reared its head. There was a vicious growl, followed by a succession of grunts as the enormous brute wheeled around and vomited earth and stone into the waiting motor truck. The great animal snapped its jaws like an Allosaur licking its chops. There was a prolonged hissing, broken at intervals by wicked snorting, and again the fangs ground deep and the jaws locked.

"Three times the steel mastodon ground its teeth into the mountain side. Three times the huge mouth opened over the motor truck. Then, the truck was filled to overflowing with almost five yards of 'muck.'

"The monster rested for a period, throbbing with the joy of conquest and defiantly belching forth steam and smoke and fire. It was like mighty Moloch of the Amalekites, chuckling with glee."

Snow Fall on New Mexico's Roads

It may interest and surprise many to learn that snow fell in considerable quantities in New Mexico last January. In the reports of the several maintenance patrols for that month, twenty-two spoke of the snow, some stating that it greatly aids maintenance; others that "the maintenance outfit was busy most of the time in removing snow and keeping the road open to traffic." "Roads have been kept passable, but drifting snow has been difficult to handle."

City Paving Done In 1925

Supplementing tables published last month, from questionnaires received since tabulating of them began. About seven hundred and fifty questionnaires, answered by municipal paving officials, form the basis of these tables.

Concrete Pavements Laid in 1925

City and State	Reinforced Concrete: Amount Sq. Yds. or Miles	Reinforced Concrete: Cost	Reinforcement Wt. per 100 sq. ft.	Not Reinforced: Amount Sq. Yds. or Miles	Not Reinforced: Cost
Arkansas:					
Hot Springs	.....	.....	.....	72,000	$198,000a
Jonesboro	.....	.....	.....	450A	.....
Pine Bluff	8,000	.....	.....	.....	.....
California:					
Newport Beach	.....	.....	.....	179,000	320,000g
Redlands	.....	.....	.....	659	1,017
Salinas	.....	.....	.....	22,222	45,000
San Louis Obispo	.....	.....	.....	8,889	20,000
South Pasadena	.....	.....	.....	22,222	49,000g
Vallejo	.....	.....	.....	10,000	18,000
Illinois:					
Genesee	.....	.....	.....	28,000	60,000
Johnston City	2 mi.	.....	.....	.....	.....
Oak Park	.....	.....	.....	81,822	262,302g
Quincy	.....	.....	.....	10,990	25,800c
Wilmette	.....	.....	.....	5,000	3.00s
Indiana:					
Hammond	99,873	$329,279a	.....	.....	.....
Kentucky:					
Covington	20,000	48,000	.....	.....	.....
Louisiana:					
New Orleans	1,925	6,737c	45 to 50 lbs.	.....	.....
Maryland:					
Baltimore	.....	.....	.....	146,500 78,900A	360,00k 175,00k
Easton	.....	.....	.....	3,320	9,378
Massachusetts:					
Webster	5001	4,400g	.....	.....	.....
Michigan:					
Benton Harbor	.....	.....	.....	1,648	2,400c
Missouri:					
Independence	13,406	33,515e	40 lb. mesh	.....	.....
Montana:					
Havre	23,050	90,780v	40 lb. bars	.....	.....
Nebraska:					
Plattsmouth	11,429	21,372c	30 lb.	.....	.....
New Jersey:					
Camden	.....	.....	.....	3,523	8,687g
New York:					
Auburn	21,345	95,284a	Fabric	.....	.....
Brookhaven	13,072	34,833	65 lb. bars & fabric	.....	.....
Niagara Falls	.....	.....	.....	9,464	47,021l
Patchogue	6,851	16,786	65 lb., bars & fabric	.....	.....
White Plains	15,416	52,764	.....	.....	.....
Ohio:					
Akron	10,000	60,000f	46.9 lb.	.....	.....
Ashland	1,032	5,145p	45 lb. mesh	.....	.....
Pennsylvania:					
Oil City	1,997	9,626d	Bar	.....	.....
Philadelphia	3.4 mi.	120,000	.....	.....	.....
Uniontown	20,243	66,000a	.....	.....	.....
Texas:					
Paris	800	2,080	.....	.....	.....
Temple	27,332	79,883a	.....	.....	.....
Wichita Falls	.....	440,374k	85 lb. bars	.....	.....
Washington:					
Olympia	.....	.....	.....	2 mi.	90,000f
Seattle	.....	.....	.....	790,000	2,112,500
West Virginia:					
Huntington	.....	.....	.....	44,954	204,105a

A—Alley paving.
a—Entire paving job. b—Entire improvement. c—Concrete only. d—Includes grading and drainage. e—Includes curb and gutter. f—Includes grading, curb, walks, etc. g—Includes grading. i—Includes grading, drains catch basins and curbs. k—Includes grading and curbs. l—Lineal feet. p—Includes grading, curbs, storm sewers, engineering, etc. s—Per square yard. v—Includes grading, curb and storm sewers.

Cement Sidewalks Laid in 1925

City and State	Amount Sq. Ft. or Mi.	Cost
Arkansas:		
Jonesboro	18,000	.....
Pine Bluff	25,000	.....
California:		
Monrovia	18,000	$2,500
Newport Beach	303,000	71,000g
Richmond	248,850	52,000
Santa Paula	9,000	1,500
South Pasadena	5,000	900
Florida:		
Coral Gables	2,700,000	540,000
St. Petersburg	102,826	17,471
Illinois:		
Genesee	2,000l	.....
Oak Park	82,669	27,704
Staunton	15,472	a
Indiana:		
Hammond	496,325	110,098
Martinsville	15,000c	2,400
Iowa:		
Fort Dodge	18,721	2,543

City and State	Amount	Cost
Kentucky:		
Covington	20,000	5,200
Henderson	16,000	.....
Maryland:		
Baltimore	681,849	140,378
Massachusetts:		
Haverhill	33,660	10,098
Lawrence	36,927	2.15s
Mansfield	27,000	.....
Webster	5,967	3,417
Minnesota:		
Stillwater	7,487	1,038
Missouri:		
Independence	28,877	5,971
Nevada	4 mi.	.....
Nebraska:		
Plattsmouth	1,800	400
Reno	67,500	12,150
New Jersey:		
Camden	333,653	116,783b
Nutley	54,000	15,000
Westfield	8,3611	7,132
New York:		
Auburn	31,640	8,504
Jamestown	99,000	16,980
Niagara Falls	83,477	19,200
Ohio:		
Akron	137,250	37,400
Jackson	5,000	1,000
Piqua	18,277	2,742
Pennsylvania:		
Midland	4,590	1,377
Oil City	8,218	2,109
Tennessee:		
Knoxville	198,000	33,000
Texas:		
Fort Worth	85,500	15,390
Lufkin	20,000	5,000
Paris	81,000	13,600
Wichita Falls	156,000	30,000
Washington:		
Seattle	1,863,000	480,000
West Virginia:		
Huntington	18,000	1,200

a—Laid by property owner. b—Includes 9.216 cu. yds. of grading and 48,585 ft. of cement curb. c.—Private contracts not included. d.—No excavation included. g.—Includes grading. l.—Lineal feet. s.—Per square yard.

Black Base Pavements

City and State	Kind of Wearing Surface	Date Laid
Ontario, Cal.	Asphalt concrete	1922-1925
Richmond, Cal.	Warrenite, Nat.	....
Salinas, Cal.	Asph. concrete	1922
Santa Paula, Cal.	Asph. concrete	1916-1924
South Pasadena, Cal.	Seal asphalt	1925
Vallejo, Cal.	Bitulithic	1919-1925
Boulder, Colo.	Warr-bitulith.	1924
Twin Falls, Ida.	Bitulithic	1910
Quincy, Ill.	Sheet asph.	1924-1925
Independence, Mo.	Asph, tar conc.	1925
Reno, Nev.	Asph. concrete	1920-1925
Trenton, N. J.	Asphalt	1921
Akron, O.	Sheet asph, brick	1925
Oil City, Pa.	Sheet asphalt	1922 & 1925
Fort Worth, Tex.	Bitulithic	1925
Wichita Falls, Tex.	Sheet asphalt	1925
Ogden, Utah	Warr-bitulith.	1923

Use of Brick Less Than Four Inches Thick

City	Amt. Laid, Square Yards	Thickness, inches	How long in service
Quincy, Ill.	80,000	3	3 & 4 years
New Orleans, La.	6,210	3½	1 year
Benton Harb., Mich.	45,000	3	2 to 4 years
Ashland, O.	3,216	3½	6 months
Bremen, O.	4,779	3	....
Jackson, O.	.....	3 & 3½	5 years
Wilmington, O.	78,191	3¼	2 years
Midland, Pa.	4,300	3½	3 months
Oil City, Pa.	.....	3 & 3½	2 to 8 years
Philadelphia, Pa.	10,000	3	2 years
Sayre, Pa.	19,000	3½	1 year
Columbia, S. C.	.....	3½	3 years
Fort Worth, Tex.	20,759	2½ & 3	13 years
Temple, Tex.	100,000	2½ & 3	1 to 14 years
Wichita Falls, Tex.	.....	3	1 to 3 years
Huntington, W. Va.	60,000	3 & 3½	1 year
LaCross, Wis.	121,000	3	3 years

Rock Asphalt and Bituminous Macadam

City and State	Rock Asphalt: Amt. Sq. Yds. or Mi.	Rock Asphalt: Cost	Bituminous Macadam: A—Asphalt; T—Tar: Amt. Sq. Yds. or Mi.	Bituminous Macadam: Cost
Arkansas:				
Pine Bluff	6,000	.....	.....	.....
California:				
Ontario	.....	.....	17,778A	$19,200g
Pittsburg	.....	.....	11,466A	31,500e
Redlands	.....	.....	88,624A	89,371
Richmond	.....	.....	0,63A	10,000g
Salinas	.....	.....	11,333A	12,000
Santa Paula	.....	.....	2,000A	1,250g
South Pasadena	.....	.....	23,333A	24,000g
Florida:				
Coral Gables	.....	.....	900,000A	1,200,000g
Kentucky:				
Covington	2,000	$6,300g	.....	.....
Louisiana:				
New Orleans	19,831	31,728c	.....	.....
Massachusetts:				
Easthampton	.....	.....	10,540T	31,162e
Haverhill	.....	.....	12,300A	70,800g
Lawrence	.....	.....	67,171T	2.25s
Mansfield	.....	.....	4,500T	.....
Webster	.....	.....	1,06T	28,934g
Wellesley	.....	.....	1,000T	.....
New Jersey:				
Newton	.....	.....	2,500A	4,000h
Nutley	.....	.....	8,000A	16,000b
Summit	.....	.....	3,562T	7,817i
Trenton	.....	.....	25,000A	45,000j
Westfield	.....	.....	23,971T	49,717e
Pennsylvania:				
Philadelphia	.....	.....	7.7 A & T	200,000
Texas:				
Fort Worth	7,631	21,367d	..... T	.....
Port Arthur	.....	.....		83,500
Temple	.....	.....	600A	300d

a—Entire improvement. b—Entire paving job. c—Wearing course only. d—Wearing course and base. e—Wearing course, base, grading and curb. g—Pavement and grading. h—Includes grading and drainage. i—Scarifying and grading old macadam, adding 3 in. penetration surface, cobble gutters. j—Includes grading, inlets, curb and gutter.

Stone Block and Brick Pavement Laid in 1925

City and State	Stone Blocks: Amount Sq. Yds. or Mi.	Stone Blocks: Cost	Brick: Amount Sq. Yds. or Mi.	Brick: Cost
Florida:				
St. Petersburg	.....	.....	256,236	$896,826
Louisiana:				
New Orleans	6,218	$37,308c	50,502	143,930c
Maryland:				
Baltimore	7,300	35,000f	.....	.....
Massachusetts:				
Lawrence	7,702	1	.....	.....
Michigan:				
Benton Harbor	.....	.....	9,386	50,929j
Nebraska:				
Plattsmouth	.....	.....	6,679	19,167d
New Jersey:				
Camden	680k	3,444e	.....	.....
Nutley	1,153	6,000e	.....	.....

New York:				
Auburn	.....	.....	.....	95,284b
Jamestown	.....	.....	70,482	288,363f
Niagara Falls	.....	.....	29,623	197,883l
Ohio:				
Akron	.....	.....	100,000	800,000m
Ashland	.....	.....	3,216	16,058n
Bremen	.....	.....	4,779	13,894f
Clarksville	.....	.....	10,057	28,229
Pennsylvania:				
Oil City	.....	.....	428	p
Philadelphia	418,000	1,775,000e	15,000	85,000r
Sayre	.....	.....	19,000	88,884f
Texas:				
Fort Worth	.....	.....	22,807	62,720d
Temple	.....	.....	35,400	118,000d
Wichita Falls	.....	.....	.....	62,396f
West Virginia:				
Huntington	.....	.....	111,663	600,914b
Wisconsin:				
LaCrosse	.....	.....	34,600	131,900

a—Entire improvement. b—Entire paving job. c—Wearing course only. d—Wearing course and base. e—Wearing course, base and grading. f—Wearing course, base, grading and curb. i—Paid $3.81 per sq. yd. for blocks delivered on work, 48 cents for laying and ramming; city did excavating and grouting. Estimated total cost $6.00. j—4 in. brick on 6 in. concrete base, curb and gutter. k—Reclipped. l—Wearing surface, base, grading, curb, catch basins, etc. m—Everything, including cement walks. n—Includes grading, curb, storm sewers, catch basins, and 4 per cent. for engineering, printing, etc. p—Laid by city forces, no record of cost. r—Does not include brick gutters.

Macadam and Gravel Constructed in 1925

	Waterbound Macadam		Gravel	
	Amount		Amount	
City and State	**Sq. Yds. or Mi.**	**Cost**	**Sq. Yds. or Mi.**	**Cost**
Arkansas:				
Jonesboro	.....	.....	7,000	.....
California:				
Santa Paula	.....	.....	1 mi.	d
Idaho:				
Twin Falls	.....	.....	22,000	$11,000e
Indiana:				
Martinsville	.....	.....	5 blocks	800
Maine:				
Bar Harbor	.....	.....	5,333	.....
Massachusets:				
Mansfield	.....	.....	10,500	.....
Wellesley	.....	.....	3,667	1,400f
Minnesota:				
Stillwater	.....	.....	2,478	3,726
Missouri:				
Nevada	.....	.....	50,000	.....
Nebraska:				
Plattsmouth	.....	.....	22,000	5,878
New Jersey:				
Keansburg	.....	.....	26 mi.	.....
Ohio:				
Piqua	9,440	$10,856h	.....	.....
Texas:				
Lufkin	.....	.....	15,000	0.80s
Paris	.....	.....	600	300
Port Arthur	.....	.....	8 mi.	35,000
Temple	.....	.....	5,000	2,400
Weatherford	.....	.....	30 mi.	.....

d—By day labor. e—Includes grading, engineering, legal publication, etc. f—Rebuilt. h—No excavation included. s—Per square yard.

Sheet Asphalt and Asphalt Concrete Pavements Laid in 1925

	Sheet Asphalt Pavements		Asphalt Concrete	
	Amount		Amount	
City and State	**Sq. Yds. or Mi.**	**Cost**	**Sq. Yds. or Mi.**	**Cost**
California:				
Ontario	.....	.....	88,889	$104,000e
Redlands	.....	.....	11,299	26,338
South Pasadena	.....	.....	1,000	1,200e
Vallejo	710	$1,420d	.....	.....
Illinois:				
Oak Park	53,118	406,459f	.....	.....
Quincy	48,925	115,000f	20,340	57,273f
	48,960	69,463c	12,945	13,282c
Wilmette	.....	.....	19,317	39,917
Kentucky:				
Covington	12,000	45,000d	.....	.....
Henderson	45,143	133,172e	.....	.....
Maryland:				
Baltimore	254,100	1,000,000f	.....	.....
Massachusetts:				
Haverhill	.....	.....	54,500	32,100e
Michigan:				
Benton Harbor	14,765	1.15sp	3,550	4,103f
Missouri:				
Independence	.....	.....	59,239	46,000
Nevada:				
Reno	67,363	123,995b	.....	.....
New Jersey:				
Camden	125,880j	443,271e		
	41,593k	90,432	.....	.....
	2,500l	7,661		
Summit	11,535	41,110f	.....	.....
Trenton	14,700	89,682v	.....	.....
New York:				
Niagara Falls	48,830	282,082	8,316	45,491v
Ohio:				
Akron	150,000	1,005,000z	.....	.....
Martinsville	.....	.....	10,232	28,721
New Vienna	.....	.....	12,450	39,074
Wilmington	12,160	60,152	.....	.....
Pennsylvania:				
Oil City	7,118	26,419h	.....	.....
Philadelphia	680,000	2,890,000m	.....	.....
South Carolina:				
Columbia	11,716	20,968	.....	.....
Tennessee:				
Knoxville	.....	.....	10,300	20,000d
Texas:				
Port Arthur	84,712	423,560	.....	.....
Utah:				
Ogden	.....	.....	81,620	235,943f
Washington:				
Seattle	.....	.....	7,500	13,500
West Virginia:				
Huntington	28,668	204,739b	.....	.....
Wisconsin:				
Fond du Lac	12,364	18,175e	23,005	57,976e

a—Entire improvement. b—Entire paving job. c—wearing course only. d—Wearing course and base. e—Wearing course, base and grading. f—Wearing course, base, grading and curb. h—Wearing course, base, grading, curb and drainage. j—On concrete foundation. k—Over old pavements. l—On trap rock foundation. m—Brick gutters on about 10 per cent.; includes base and subgrading, or removal of old wearing surface in repaving. p—Resurfacing. s—Per square yard. v—Grading, base, surface curb and gutter and inlets. z—Wearing course, base, grading, curbs and sidewalks.

Special Kinds of Pavements Laid in 1925

City and State	Amount Sq. Ft. or Mi.	Cost
WARRENITE-BITULITHIC		
Salinas, Cal.	35,555	$48,000
Vallejo, Cal.	5,500	5,500c
New Orleans, La.	62,874	93,682c
Lawrence, Mass.	13,654	2.05sc
Auburn, N. Y.	5,127	24,679
Niagara Falls, N. Y.	4,398	25,858h
White Plains, N. Y.	4,906	24,467
Valley City, N. D.	16,193	69,000
Fort Worth, Tex.	20,751	63,351d
VIBROLITHIC		
Fort Dodge, Ia.	10,950	26,586
Nutley, N. J.	36,385	117,000g
ASPHALT BLOCK		
St. Petersburg, Fla.	139,014	486,549
Niagara Falls, N. Y.	19,526	122,178h
Ashland, O.	12,024	69,712f
Piqua, O.	2,850	7,267c

c—Wearing course only. d—Wearing course and base. e—Pavement, grading and curb. f—Includes grading, curb, storm sewers, catch-basins and 4% for engineering, printing, etc.

In addition to the special kinds of pavements tabulated, several, each reported by only one city, are given below:

Amiesite—Fort Worth, Tex., 15,071, $42,200d.
National—Richmond, Cal., 4.87 mi., $191,000.
Willite—Wichita Falls, Tex., $235,768e.
Casemco—New Orleans, La., 24,386, $25,605c.
Bitulithic—New Orleans, La., 2,956, $3,872c.
Creosoted Wood Block—New Orleans, La., 1,428, $4,712c.

Used For Laying Dust

Materials reported by municipal officials as being used by them for laying dust on city streets. Asphalt and tar oils and calcium chloride those most commonly used.

OIL

Alabama: Huntsville (heavy oil); *Arizona*: Prescott (crude oil); *Arkansas*: Ft. Smith; *California*: Long Beach, Orange, Visalia; *Colorado*: Denver; *Connecticut*: Bristol, Meriden, New Britain ("dust-layor") Willimantic; *Georgia*: Americus; *Illinois*: Batavia, Cairo, Calumet City, De Kalk, Dixon, Jerseyville, Kankakee, Kewanee, Lake Forest(residual oil), Metropolis, St. Joseph, Sycamore, Waukegan; *Indiana*: Attica, Bluffton, Boonville, Frankfort, Goshen, Huntington, Jeffersonville, Lebanon, Logansport, Mt. Vernon, Noblesville, Seymour; *Iowa*: Decorah, Keokuk, Mechanicsville; *Kansas*: Kansas City; *Kentucky*: Dayton (light oil), Georgetown, Lexington, Ludlow, Owensboro; *Maine*: Augusta, So. Portland; *Massachusetts*: Andover, Gardner, Great Barrington, Lee, N. Adams, Orange, Saugus; *Michigan*: Albion, Ann Arbor, Battle Creek, Bay City, Hastings, Kalamazoo, Ludington; *Minnesota*: Cloquet, Duluth, Mankato, Minneapolis, St. Paul, So. St. Paul; *Missouri*: Boonville, Hannibal, Joplin, Kansas City, Marshall, St. Charles, Sedalia, Webb City; *Montana*: Billings, Great Falls (residual oil), Kalispell, Miles City; *New Hampshire*: Keene (No. 6 road oil); *New Jersey*: Vineland; *New York*: Amsterdam, Elmira, Endicott, Glens Falls (heavy oil), Gloversville, Herkimer, Ithaca, Johnson City, Lackawanna, New York, Oneonta, Perry, Rye, Saranac Lake; *Ohio*: Barberton, Cincinnati, Circleville (crude oil), Delaware, Elyria, Hillsboro, Huron, Lancaster, Lima, Lorain, Middletown, St. Marys, Troy, Xenia; *Oklahoma*: Muskogee, Wagoner; *Pennsylvania*: Altoona, Clearfield, Coatesville, Ellwood City, Luzerne, Warren, Washington, Williamsport; *South Dakota*: Watertown; *Vermont*: Bennington, Rutland, St. Albans (No. 4 road oil); *Wisconsin*: Antigo, Eau Claire, Kenosha, Lake Geneva, Racine, So. Milwaukee, Superior.

Illinois: Genesee, Staunton. *Indiana*: Tell City. *Kentucky*: Covington, Danville. *Massachusetts*: Amesbury, Haverhill. *New Jersey*: Keansburg, Trenton (light). *New York*: Jamestown, Patchogue. *Ohio*: Akron, Carrollton, Jackson (light), Piqua, Wilmington. *Texas*: Fort Worth. *Wisconsin*: Fond du Lac, La Crosse.

ASPHALTIC OIL

California: Pasadena; *Connecticut*: Hartford, Middletown, New London, Putnam; *Indiana*: Ellwood; *Maine*: Portland; *Massachusetts*: Greenfield, Lowell, Newton, Pittsfield, Stoneham, Winchester; *Michigan*: Sault Ste. Marie; *Minnesota*: New Ulm; *New Hampshire*: Laconia; *New Jersey*: Flemington, Newark; *New York*: Hudson, Oneida; *Ohio*: Dayton, Warren; *Pennsylvania*: Allentown, Chambersburg, Easton, New Brighton, Morristown; *Rhode Island*: Woonsocket; *Virginia*: Harrisonburg; *Wisconsin*: Oshkosh, Ripon.

Illinois: Zion (60 per cent.). *Montana*: Havre (42 per cent.). *New York*: Auburn. *Pennsylvania*: Philadelphia, Sayre (55 per cent.)

TAR.

Connecticut: Hartford, Meriden, Middletown; *Massachusetts*: Melrose, Newton; *Michigan*: Marquette; *New Jersey*: Flemington; *Pennsylvania*: Chambersburg; *Virginia*: Suffolk.

TARVIA

Illinois: Winnetka; *Indiana*: Rensselaer; *Maine*: Augusta, So. Portland; *New York*: Glens Falls, Lancaster; *Pennsylvania*: Allentown, Bangor, Easton, Lebanon; *Wisconsin*: Burlington.

Minnesota: Stillwater. *Pennsylvania*: Perkasie.

TARVIA B

Connecticut: Wallingford; *Illinois*: Freeport, Rockford; *Indiana*: Richmond; *Massachusetts*: Adams, Andover, Gardner; *New Hampshire*: Keene; *New Jersey*: Phillipsburg; *New York*: Watertown, Tarrytown; *Pennsylvania*: Berwick, Lansford, Morristown, Sewickley, Shippensburg; *Vermont*: Montpelier; *Wisconsin*: Green Bay, Oshkosh.

Massachusetts: Mansfield (45 per cent., 65 per cent. and 85 per cent.). *New Jersey*: Newton. *New York*: Auburn.

TARVIA C

Pennsylvania: Northampton.

GAS TAR.

Connecticut: Ansonia; *Massachusetts*: Greenfield; *Montana*: Helena; *Ohio*: Bellefontaine.

CALCIUM CHLORIDE.

Arkansas: Little Rock; *California*: San Rafael; *Florida*: Fernandina; *Indiana*: Huntington; *Iowa*: Charles City, Clinton, Mechanicsville, New Hampton; *Kansas*: Atchison, Lawrence; *Maine*: Bangor, Rockland, Waterville; *Massachusetts*: Gardner; *Michigan*: Albion, Alma, Ann Arbor, Coldwater, Dowagiac, Hastings, Houghton, Ironwood, Lansing, Ludington, Mt. Pleasant, Negauna, Niles, Owasso, Pontiac, Port Huron, Traverse City; *Minnesota*:

Chisholm, Faribault, Mankato, Montevideo, So. St. Paul; *Missouri*: Carthage, Hannibal; *New Jersey*: Belleville; *New York*: Endicott, Massena; *North Carolina*: Mt. Airy; *Ohio*: Lancaster, Massillon, Youngstown; *Pennsylvania*: Altoona, Carbondale, Freeland, Mt. Carmel, Sharon, Williamsport; *South Dakota*: Rapid City, Watertown; *Vermont*: Bennington, Montpelier, Newport (Cemet Solvay), St. Albans; *Wisconsin*: Kenosha, Manitowoc, Merrill, Tomahawk.

Massachusetts: Easthampton. *Michigan*: Benton Harbor. *Minnesota*: Stillwater. *New Jersey*: Keansburg, Newton, Nutley. *Ohio*: Wilmington. *Pennsylvania*: Oil City. *Wisconsin*: Fond du Lac.

DOW FLAKE.

Indiana: Logansport; *Minnesota*: Rochester; *Missouri*: Joplin; *North Carolina*: Raleigh; *Ohio*: Urbana, Zanesville; *Vermont*: Newport; *Wisconsin*: Green Bay.

Iowa: Fort Dodge.

MISCELLANEOUS.

Additional materials reported by only one or two cities are: Dustoline by Hartford, Conn. Ugite with stone chips by Hanover and Huntington, Pa. Glutrin by Covington, Va. Screenings by Napa, Cal. Waterloo, Ia. paves a street when it gets too dusty. In Orange, N. J. "All streets where dust layer was formerly used now have carpet covering of asphalt and clay or stone chips."

Quick Hardening Cements

The use of quick hardening cements is reported by the following cities. Unless otherwise stated the cement used was "lumnite." The purpose for which the cement was used, when reported, is given in parenthesis.

California: Newport Beach.
Florida: Lake City.
Iowa: Fort Dodge.
Kentucky: Covington.
Louisiana: New Orleans.
Maryland: Baltimore (repairs only.)
Massachusetts: Haverhill and Webster.
Michigan: Benton Harbor.
New Jersey: Nutley (repairs), Trenton (repairs), Westfield (repairs).
New York: Auburn (not in paving work), Brookhaven, Niagara Falls.
Ohio: Akron (under car tracks), Ashland (repairs.)
Pennsylvania: Philadelphia.
Tennessee: Knoxville (repairs).
Washington: Olympia (patches), Seattle (repairs).
Wisconsin: Fond du Lac (patching).

America's Highest Head Power Plant

The San Joaquin Light and Power Corporation expects to have in operation within a year on Kings river, in central California, a power station operating under a static head of 2,470 feet. A dam 65 feet high and 190 feet long at the crest is now under construction and when complete will form a 200-acre-foot surge pond. Later, when other plants are added, a larger dam will probably be built at the same site, with a possible height of 175 feet and length of 800 feet. The diversion dam will have a crest elevation of 4065 feet, while the ultimate structure will raise the elevation to 4,180 feet and create a 5,000 acre-foot surge basin. It is planned to carry water from the diversion dam to the penstock, a distance of 19,500 feet, in a tunnel cut through solid granite with 12x12 ft. cross section and a slope of 0.33 per 100. Steel penstocks about 4,700 ft. long will connect the tunnel exit, at elevation 3,966, with the nozzles at elevation 1,710—a drop of 2,256 feet in 4,700. The upper 3,500 feet of penstock will be a single pipe, but from there down two smaller pipes will be used because of the extreme pressure

The power generated will be stepped up to 132,000 volts and transmitted 39 miles to the Sanger substation of the San Joaquin system. It is estimated that the entire project will cost $50,000,000.

Asphaltic Roadway Surfacing

Editor, Public Works,
New York, N. Y.
Dear Sir:

From a valuable and interesting article in "Public Works" issue of December, 1925. "Effect of Pleasure Traffic on Bronx Park Roads" by L. G. Holleran, Deputy Chief Engineer of the Bronx Parkway Commission, we quote:

"Several years observation of the effects of the intensive motor vehicle traffic over the various types of pavement, leads to the conclusion that the effect of pneumatic and balloon tires on the bituminous concrete surface does not cause ravelling or appreciable wearing of the surface if the seal coating is properly applied in the first instance. If the seal coating wears away, exposing the crushed stone aggregate, there is a decided tendency for the surface to disintegrate due to the suction caused by the movement of the tires over the surfacing. The remedy for this tendency is to maintain the pavement so that its surface always has an adequate seal coat."

In the comparatively early development of Warrenite-Bitulithic Pavement under intensive traffic, Warren Brothers Company learned that the then seal or flush coating of bitumen (being then 1-16 inch depth, which is all that could be used without making a gummy surface) into which sand or stone chips was rolled, wore away in a comparatively short time under traffic and the elements. To overcome this, it developed the use of "fine surfacing mixture" in lieu of the former "flush" or "seal" coat. This "fine surfacing mixture" is spread over the lower coarse aggregate mixture while the latter is hot and plastic and before it is fully compressed. The two courses are then blended and bonded together by heavy rolling. The fine surfacing mixture is spread to a depth which, if compressed on a smooth plane, would provide a structure of about one-half inch, about half of which is pressed into and the balance remains over the lower coarse aggregate mixture. Under this construction, which removes the danger of shifting of the fine surfacing mixture, it is made softer in penetration and richer in percentage of bitumen than would otherwise be practicable.

The result is:

(a) Body of the wearing surface course stable and weight resisting.

(b) Surface finish of substantial depth of asphaltic mixture having the highest degree of moisture and wear resistance.

(c) The two courses bonded and blended into an inseparable mass capable of the greatest degree of traffic and element resistance.

Briefly stated, this is the construction which we have employed during the past twelve years.

Yours very truly,
George C. Warren,
Chairman, Executive Committee,
Warren Brothers Co.

Recent Legal Decisions

ERECTION OF WATERWORKS BOARD HEADQUARTERS HELD A PUBLIC WORK

The Connecticut Supreme Court of Errors holds, Stevens v. Board of Water Com. of Hartfor, 128 Atl. 713, that the erection of a headquarters building by the board of water commissioners of a city is "a public work or improvement" within 18 Special Laws, 1921, p. 859, and the board is a branch of the city government; so that its vote ordering the construction of the building must be submitted for approval at a city meeting.

POWER OF MUNICIPALITIES TO MAINTAIN GOLF COURSES

The Florida Supreme Court, City of Bradentown v. State, 102 So. 556, holds that, while the Legislature might authorize municipalities, within appropriate limitations for the protection of taxpayers, to purchase and maintain golf courses to be impartially conducted in the interest of the local public, thereby declaring it to be a municipal purpose, the courts should not, by deducing such authority from general powers conferred upon municipalities, anticipate express legislation conferring upon municipalities the specific power to establish and maintain golf courses.

ORDINANCE REQUIRING STREET LIGHTS AT RAILROAD CROSSINGS UPHELD

The Louisiana Supreme Court holds, State ex rel. City of Oakdale v. Missouri Pacific Ry. Co., 102 So. 86, that an ordinance requiring a railroad to install and maintain street lights at crossings in the centre of a city where trains were switched nightly was not unnecessary or unreasonable although no regular train ran over the crossings at night.

ORDINANCE REQUIRING STORAGE OF KEROSENE AND GASOLINE UNDERGROUND HELD NOT INVALID ON ITS FACE

The Kansas Supreme Court holds, Cities Service Oil Co. v. City of Marysville, 231 Pac. 1031, that under a statutory power to enact all such ordinances as may be expedient for maintaining the welfare of the city, the council may regulate the manner in which kerosene and gasoline may be stored within the corporate boundaries; and that an ordinance forbidding the storage of such fluids (except in small quantities) otherwise than in tanks buried at least three feet underground is not invalid on its face. One who attacks the ordinance as unreasonable as applied to a particular state of facts was held to have the burden of overcoming strong presumptions in favor of its validity.

CONTRACTOR RECEIVING PRICE FOR LABOR AND MATERIALS AND FAILING TO PAY THEREFOR

The Washington Supreme Court holds, State v. Williams, 233 Pac. 285, that Rem. Comp. Stat. §2604, providing for punishment for a contractor receiving a price for labor and materials for which a lien might be filed on another's property, and failing to pay therefor, is not invalid as class legislation, or as providing imprisonment for debt; and it does not interfere with liberty of contract, since contractors must enter into their engagements with a knowledge of the act.

FOREIGN MUNICIPALITY OPERATING WATER SYSTEM IN KANSAS SUBJECT TO SUIT THERE

The Kansas Supreme Court holds, Baker v. City of Kansas City, Missouri, 233 Pac. 1012, that when a foreign municipal corporation comes into Kansas and establishes, maintains and operate a water system therein, it does not bring its sovereignty into the state, but is conducting its business there in its proprietary capacity, and for liabilities arising in Kansas from the conduct of such business there it may be sued in the courts of Kansas.

PROCEDURE IN RECONSTRUCTION OF BRIDGES

The Kansas Supreme Court holds, Klaw Valley Drainage Dist. v. Board of Comrs., 232 Pac. 1056, that a county is without power to make a valid contract for the removal of an approach to one of its bridges over a navigable stream without first complying with the requirements of Kansas. Rev. Stat. 68-1402, which provides for the preparation of plans and specifications, estimate of cost, under oath, and advertisement for bids.

PEDESTRIAN CROSSING STREET NOT OPEN TO TRAVEL DID SO AT OWN RISK

The Massachusetts Supreme Judicial Court holds, Chapman v. City of Boston, 147 N. E. 840, that where a city was engaged in raising and resetting curbstones on each side of a street, a pedestrian could not recover for injuries received in attempting to step over a trench when the edge of the trench gave way and she fell. Whether barriers had been placed to warn travelers that it was not safe to proceed was held to be immaterial since the condition of the street was apparent, and it did not appear that plaintiff might not have crossed safely in another place.

WORKMEN ON MUNICIPAL PUBLIC UTILITY HELD NOT ENGAGED IN PUBLIC WORK WITHIN OHIO EIGHT HOUR DAY ACT

The Supreme Court of Ohio, State v. Peters, 147 N. E. 81, holds that section 17-1 Ohio General Code has no application to the employment of labor by a municipality in the operation of a public utility owned by it. The expression "workmen engaged on any public work carried on or aided by the state, or any political sub-division thereof, whether done by contract or otherwise," is held to relate to the construction of public improvements and not to their maintenance or operation.

COUNTY HELD NOT LIABLE FOR INJURY TO CROPS FROM OVERFLOWING DITCH

The Iowa Supreme Court holds, Van de Walle v. Tama County, 201 N. W. 44, that a county, irrespective of the question of negligence, is not liable

for injury to crops from the overflow of a ditch alongside a highway.

SUFFICIENCY OF EXCAVATION AND WALL UNDER PLANS

The plan of a filter plant building for a city required, if "soft material" was encountered, that it be removed and a foundation wall placed on a specified concrete footing. The Minnesota Supreme Court held, in an action for balance of the contract price, Carlson v. City of Thief River Falls, 202 N. W. 942, that there was thereby imposed upon the contractor the obligation to excavate deep enough to procure a base of sufficient firmness to support the load to be imposed. The contractor not having guaranteed the work, but having only to build as required by plans and specifications, it was held a question for the jury whether he excavated and constructed the wall as required by the plan, or, if he did not, whether he sought in due time and procured the engineer's approval. If he did not do all that was required, and did not in due time procure the engineer's approval, he was held liable for the resulting damage.

ASSIGNEE OF PUBLIC WORKS CONTRACT MUST ASCERTAIN IF RIGHTS OF LABOR AND MATERIALMEN HAVE ATTACHED

The Oklahoma Supreme Court holds, Donaldson & Yahn v. Benight, 232 Pac. 116, that public buildings and structures are not subject to labor and materialmen's liens. The statute has provided for a builder's bond in lieu of the mechanic's lien to protect the labor and materialmen. In addition thereto, municipalities and builders may contract for the municipality to pay any claims for labor and material out of the sums due the contractor which he fails to pay. The assignee of the amount due on a contract for a public building takes the assignment subject to the provisions of the contract. If the contract provides for the protection of labor and materialmen's claims out of any indebtedness owing to the contractor, the burden is on the assignee, before taking the assignment, to ascertain if the rights of any labor and materialmen have attached under the contract.

LABORERS AND MATERIALMEN MAY SUE ON CONTRACTOR'S BOND THOUGH PROVISION THEREFOR NOT IN CONTRACT

The Oklahoma Supreme Court holds, Carl v. Richards, 235 Pac. 599, that the provision for bond in the interest of laborers and materialmen, under Okla. Comp. St. 1921, §7486, was made for their protection in the construction of enterprises for the public, and, where the bond given by the contractor and signed by the sureties is in substantial compliance with the statute and contains the provision stated along with other provisions to fulfill the contract for the work to be done, the right cannot be denied and the statute nullified for failure to insert the provision in the contract.

ORDINANCE REQUIRING BUILDING PERMIT BUT PRESCRIBING NO STANDARD HELD VOID

The Kentucky Court of Appeals holds, Board of Trustees of Town of Bloomfield v. Bayne, 266 S. W. 885, that a city ordinance requiring a permit for the erection or alteration of a building which prescribes no standard with which the citizens must comply, or by which the discretion of those invested with the power to grant or refuse the permit is to be controlled, is arbitrary and invalid.

MAINTENANCE OF GARBAGE INCINERATORS—LIABILITY ONLY FOR WANT OF AUTHORITY OR NEGLIGENCE

In an action against a municipality for maintaining a nuisance in operating an incinerator near plaintiff's premises, the Alabama Supreme Court holds, City of Bessemer v. Abbott, 103 So. 446, that, under Code 1923, §2039, giving municipal corporations power to establish garbage crematories, either within or without the city limits, and to haul such substances thereto, the only basis for liability in such a case is that the act was done in excess of the authority conferred, or that it was negligently done so as to cause unnecessary injury. In this case there was no allegation in the complaint of any fact basing such liability.

IMPLIED POWERS OF MUNICIPALITY—AMENDMENT OF CITY CHARTER

The Mississippi Supreme Court holds, McClure v. City of Natchez, 103 So. 813, that power to own and operate ferries within the municipal limits does not imply power to issue bonds to raise money to purchase and operate a ferry, but such power must be expressly granted.

It is also held that an amendment to a city charter is ineffectual until recorded on the minutes of the mayor and board of aldermen; and no retroactive effect can be given to the amendment of a city charter.

TOWNS HELD "CITIES" WITHIN STATUTE AS TO BOND ISSUE—ESTABLISHMENT OF WATER, LIGHT AND SEWERAGE SYSTEM ONE PURPOSE

The Mississippi Supreme Court holds, Green v. Hutson, 104 So. 171, that towns are within the proviso to Laws 1920, C. 206, §2, as to issuing bonds of municipalities, that in "cities" of less than 12,000 inhabitants an issue of not more than $30,000 shall be without election, unless there be protest of 20 per cent. of the electors. The adjudication of the town's board of mayor and aldermen of no sufficient protest is held not subject to collateral attack.

The bond issue, which was for the purpose of establishing a water, light and sewerage system, was not void as being for a plurality of purposes, the issue being for one object, "the common purpose of establishing a municipal plant to supply the needs of the inhabitants with public necessities of a similar character."

STATUTORY NOTICE OF APPLICATION TO OPEN NEW ROAD

The Texas Court of Civil Appeals holds, Owens v. Briscoe County, 268 S. W. 963, that, in view of V. S. C. St. art. 6875, a county commissioners' court cannot grant an order to lay out a new road until 20 days notice of the intended application has been given by the applicants, as provided by the statute, the public having interests in the opening of a new road.